THE

Practical Teacher

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Edited by JOSEPH HUGHES.

'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

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Hygiene.

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MAIN SEWERS—(*continued*).

THERE are some grand principles to be observed, which are well set out by Captain Douglas Galton in his work upon 'Healthy Dwellings,' and in which he lays down the conditions to be observed in main sewerage works. He says steep gradients must be modified, by forming vertical steps, so as to prevent excessive velocity in the transit of sewage. Sewers should be water-tight, and so stop exchange in either direction; brick sewers should be set in hydraulic mortar.

Main sewers require to be provided with storm overflows in case of heavy rain. Sewers should not join at right-angles, unless a curve, with extra fall, is provided in the manhole. Greater sewers should not lose into smaller ones. An outlet sewer of two feet diameter, laid with a fall of five feet per mile, will deliver in twenty-four hours upwards of 2,000,000 gallons, flowing a little more than half fall. Lesser diameters will answer when there are greater falls.

A velocity of two feet six inches per second, with continuous flow, will remove all things likely to be found in sewers; but, if it be intermittent, there should be frequent velocity of three feet per second. A velocity of six feet per second is destructive to the sewer itself, and should not be permitted. Manholes should have moveable covers at the surface of the ground, and be placed at short distances, so as to allow of continuous examination in the whole length of the sewer. It is best to have them so fixed that a length of sewer should allow of a light at one manhole being visible from the next, when placed in the manhole at the sewer level. There will then be no difficulty in seeing whether the sewer is clear of deposit, or whether any alteration has taken place in the floor of the sewer itself. These lamp-holes should be at every junction, and at frequent intervals along all lines of small sewers. The proper construction of sewers and house-drains is the basis of good sewerage. If there is failure in this part of the work, there will never be that perfect freedom from sewer smells which ought to belong to correct sewerage construction. Attempts are made in most places to remedy defective construction by systematic flushing. This may be effectual for small defects, but it can never be sufficient when there is continuous stagnation.

The defective construction of sewers is well exemplified in some districts, in which the engineer has failed in his duty, by providing sewers which give offensive odours, whenever there are the required meteorological conditions. The local authority, afraid to meet the cost which new construction entails, is placing at various points, and at great cost, immense self-acting flushing-tanks, which will provide a partial remedy for a time, and then get out of order, entailing a continuous annual charge upon the locality. A systematic flushing, on a general principle, is always necessary, so that the crown of the sewer may be washed as well as the floor; but the cost of this is nothing compared with that kind of flushing which is required to move away the real cause of ordinary sewer smells, which arise from putrefying deposits in the floor of the sewer, and which begin again as soon as they have been removed. All kinds of suggestions are made to carry these smells away from contact with the nasal organs, except the right one; ventilating-shafts, at the dead ends of sewers, standing like extinguished lighthouses, indicating the incompetence of the original sewer constructor. These, as well as all other makeshift plans to remedy bad work, add to the cost of the thing, and tend to make people dissatisfied with sewers, and act like fools, in trying to close up the offending openings; thus leaving the cause of the mischief to go on spreading evil in unknown directions. The only true remedy is proper construction, on the principles I have indicated. The sewer should be kept as clean as the kitchen sink and the pan of the W.C.

Sewer Gas and Septic Organisms.—If house-drains and sewers are properly constructed; if the architect has designed his part of the work on correct principles, so that there is no arrest of movement in the passage of excreta from the house to the sewer; if the engineer has constructed the sewers of the district on right lines, so that the policeman's motto of '*Move on!*' can take effect—there will be no gaseous matters to be guarded against, and sewer gas will be an unknown product. Unfortunately, the view which I present

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appears to be impossible of attainment. Local boards, corporations, boards of guardians, and architects can never realise the fact that sewers and house-drains require to be kept clean, and that they cannot be kept so if they do not flush clean, if they are not correct in their levels, if there is resting-place for solid deposit, and if they are not thoroughly washed at stated intervals, so that the incrustations which form at the side of the pipe, about the level to which the sewage ordinarily runs, shall be removed before it can develop and form vegetable growths. These growths belong to the order Confervoideæ: they are produced in comparative darkness, and among changing vegetable and animal matter; they will, at certain temperatures, attain an enormous development in a short period of time. If at such times there is any stagnation in the sewage, the same effect is produced as may be seen in any brewer's vat in which fermentation is being promoted—there is a tremendous production of gas. Let this time be coincident with a warm rainfall; the lower end of the sewer becomes waterlogged, there is a backwater in the sewer, fermentation proceeds '*pari passu*' with the confervaceous growth, and the gaseous produce in a few minutes equals the cubical contents of the sewer itself. As a consequence, air is displaced and sent into the houses; or, if these are protected by intercepting traps and ventilating pipes, the gaseous product is discharged into the courts, alleys, yards, and streets of the town; or, on the other hand, there may be active putrification in the solid deposit at the bottom of the sewer, which is stirred up by the sudden rainfall, and sewer gases of the sulphuretted hydrogen type are produced in immense quantities. If we examine the carbonic acid gas which escapes from a brewer's vat—if it be collected as it issues from the vat, and is transmitted by a pipe from the vat into a solution of sugar—the gas appears to do that which alone it would not be possible for it to effect. The saccharine fluid undergoes fermentation. This action proves that which the microscope is also able to tell us—viz., that the CO_2 has carried with it germs of the yeast fungus. This fungus, in its various forms, with other plants allied to it in function belonging to the natural order Confervoideæ, and which have place among the Algals, rapidly promotes alteration in the chemical constitution of the sewage with the production of gaseous matters, and which go by the comprehensive term of sewer gas. It consists of carbonic acid, carburetted and sulphuretted hydrogen, and other compounds more or less offensive. The gases may carry with them, as they escape in bubbles from the sewage, various minute germs of two distinct kinds. One kind may be likened to sprouting seeds which are capable of taking root and growing immediately, provided they attach themselves to proper cultivation areas, such as the mucous membrane of the nose and throat, if they are inhaled, and are viable. If their vitality has not been lowered too much, they at once commence to fructify in their new home, and thus set up diseases of various kinds, such as scarlatina, diphtheria, measles, whooping-cough, erysipelas, typhoid fever, diarrhœa, so called febricula, catarrhs, and infective pneumonia. The germs may be viable at first issue from the sewer, but they rapidly lose that viability after exposure, for a few seconds only, and by movement in a purer atmosphere; so that if they are not inhaled immediately, they quickly die, and lose their power of reproduction. Each germ probably differs from its fellow of another kind in the length of time at which it may be viable; there may be a difference in the meteorological conditions which are required for diffusion. These germs have their origin in the excreta, and in products derived from similar cases, which have been passed into the sewers at some part of their distribution, but not necessarily above the opening of egress. It follows, therefore, that districts in which there are distinct sewer smells are districts in which it will be very difficult to eradicate the diseases which I have enumerated; because their germs are more or less kept bottled up in the sewers, ready to spring into active and offensive existence whenever sewer construction and meterological conditions favour their dispersion. Besides these sprouting seeds of disease—which are easily destroyed, and which soon disappear if they are not planted out at once—there is another class, which are much more persistent. They are found in the deposit of sewers, and may be in all filth-deposits of an animal nature, as well as in the fresh excreta. They are analogous to the resting spores, which belong to the order of Algals and Fungals. They may be likened to ordinary seeds in their quiescent state; they have not begun to fructify, they are not sprouting, and may be taken from one part of the country to another without much chance of destruction by the journey. They are like to the germs of small-pox or vaccine, which are contained in the vesicles and pustules belonging to those diseases. They may be kept for considerable lengths of time, and may be preserved from decay by the very means which are too often resorted to for the purpose of destroying them, viz., disinfection. Thus they may be covered over by carbolic acid and other disinfectants, which are extremely valuable in destroying the spouting spores, but which are perfectly useless as against the resting spores. Disinfectants may even assist to perpetuate mischief by preventing the decay of its seeds. They remain in a dormant state until they are transmitted to a favourable cultivation area, when they incubate and produce fresh crops of active spores. They are often transmitted by water; or, being dried up in the living-room, on the roadside, or anywhere else, are blown about by draughts and the wind until they come into contact with favourable soil. Complete destruction can only be effected either by heat or growing vegetation. Sewage which is conveyed at once to the farm will be at once deprived of its noxious power by being placed in positions by means of which disease germs retrograde rather than advance, so that real destruction is brought about. They are made food for vegetable life instead of being allowed to grow in animal juices. It is one of the greatest facts in connection with disease-prevention that growing vegetables are able to deal with disease germs or septic organisms in a way which renders them perfectly innocuous. It seems, therefore, to be the design of Providence that safety is to be found in cultivation of the soil with human excreta, and in that way alone can we hope to escape evil.

Storage must not be permitted, neither on the farm nor anywhere else. Fire cannot be used for the destruction of human filth: it must go on to the land, and be utilised at once, if we would have health; and by going there, food is produced, and famine guarded against.

(To be continued.)

The New Class-Subject, 'Elementary Science.'

(What to teach, and how to teach it.)

BY RICHARD BALCHIN.

CONTINUING the notes of the easy lessons on this subject for Standard V., we have :—

LESSON XXIII.—CARBON.

Show various forms of carbon : charcoal, coke, coal, piece of cake carbon from the retorts of gas-works, soot, lampblack, Indian ink, graphite (blacklead), diamond. None of these is pure carbon except the diamond. Charcoal (char-wood ?) is made by burning wood in a closed chamber; coke (char-coal ?) by burning in the same way coal. Note why a *closed* chamber. Because if air had access, the C would combine with the O of the air to form CO_2, and so the C would waste. Cake carbon is found lining the pipes leading from the retorts at gas-works. It is cut into pointed cylinders and used for the 'arc' electric light. The boys have, perhaps, noticed that the same substance is used as the negative plate in the 'Bunsen's cell.' Soot is the carbon from coal, for the complete combustion of which there has been an insufficient supply of oxygen. Lampblack is made on a large scale 'by letting the smoke from burning resin or pitch pass into a chamber lined with leather; the lampblack collects on the sides of the chamber.' It is the principal ingredient of printer's and Indian inks.

Carbon forms a large part of all our food. Burn a piece of bread; turns black, and carbon is the result. Same with meat. Pour some strong sulphuric acid on loaf-sugar. The acid abstracts the water from the sugar, and carbon is left. Note the chief properties of carbon: 1st, it unites readily with oxygen, forming CO_2; 2nd, in combination with hydrogen, it is marsh-gas, the explosive gas of the miner; 3rd, it absorbs bad smells and arrests putrefaction.

LESSON XXIV.—CARBON COMPOUNDS.

Carbon dioxide. Recapitulate the facts we have already noted respecting this compound. Burn a piece of charcoal in a jar of oxygen, to produce carbon dioxide, and to show that it is really CO_2. Describe also the combustion of the diamond in oxygen, to prove the composition of this gem. Repeat the experiment of breathing through a glass tube into lime-water, and the combination of the lime with the CO_2 of our exhaled breath, and consequent formation of carbonate of lime, $CaCO_3$. Again, insist upon a correct description of the change brought about upon the air by animal respiration, namely, that we inhale a mixture of gases, consisting mainly of N and O, and that we exhale a mixture consisting mainly of N and CO_2. (*Note.*—I am continually hearing from boys, and even from some pupil-teachers, that we breathe *in* oxygen, and breathe *out* carbonic acid gas.) Note once more how the CO_2 present in the air is absorbed by plants, and by rain. Here, again, do not be content with the too common statement that 'leaves *take in* carbonic acid gas, and *give out* oxygen.' Insist upon at least this much of exactitude, namely, that on the surface of a leaf there are breathing pores called 'stomates.' If the boys have had a lesson upon any insect, compare these pores with the spiracles. At least two things take place at these pores:—1st, a large quantity of water is perspired, producing a partial vacuum in the body of the leaf, and a consequent rising of the 'sap' to fill the vacuum, as well as causing the deposition of solid matter in the substance of the leaf to be digested; 2nd, carbon dioxide is inhaled, and spreads among the green cells, which constitute the greater part of the material of the leaf. The action of the sunshine upon the green cells causes a breaking up or decomposition of the CO_2; the C is retained, to be digested as food by the leaf, and the O_2 is liberated.

LESSON XXV.—CARBON COMPOUNDS.

Hydro-carbons. These are compounds of hydrogen and carbon. Have up before the boys the tabulated form referred to in last month's article. Note that carbon combines with hydrogen to form marsh-gas, CH_4. Sometimes rushes out from cracks in the coal in mines; then called fire-damp. If this gaseous compound then, by any means, becomes ignited, it explodes with terrific force, and generates (1) water-vapour, (2) carbon dioxide. The explosion is, of course, the sudden combination of CH_4 with the oxygen of the air, thus :—

$$CH_4 + O_4 = CO_2 + 2H_2O.$$

This mixture of aqueous vapour (H_2O) with carbon dioxide (CO_2) is the choke-damp which always follows an explosion in coal mines, and which is even more dangerous than the original fire-damp.

All rock-oils are hydrocarbons. Benzoline may be obtained from the distillation of peat. The boys may, perhaps, have seen men from the gas-works clearing out the gas-pipes of the street lamps. If so, they must have noticed that the men thrust long canes down the pipes; and that when the cane is drawn out, it is covered with a white powder. This substance is a hydro-carbon, called naphthaline ($C_{10}H_8$); it is one of the products of the distillation of coal. If any boy can discover how to get the naphthaline vapour out of the gas before it leaves the works, he will have taken a step on the road to fortune.

In a previous lesson the boys have learnt that the flame of a burning candle is hollow. Filling up this hollow there is the combustible fat-vapour derived from the tallow of the candle. This vapour is a hydro-carbon. It is interesting to note that the combustion of this tallow-vapour—*i.e.*, its union with the oxygen of the air—generates precisely the same compounds as the combustion of the fire-damp of the miner, namely, aqueous vapour, and carbon dioxide.

LESSON XXVI.—NITROGEN.

Repeat the experiment with the bell-jar and phosphorus as described in lessons X. and XI. So lead to the fact that four-fifths, by volume, of the air, is nitrogen. By this experiment, the oxygen is removed from the air by the burning phosphorus; but oxygen may also be removed by passing air over ignited copper, though this experiment cannot conveniently be performed with the apparatus at our command. Recapitulate what

has already been said respecting the negative properties of nitrogen. Describe some of its important compounds:—(1) Ammonia, NH_3. This forms the subject of the next lesson. (2) Nitrous oxide, or laughing gas, N_2O. Dilute nitric acid, HNO_3, with ten times its volume of water, and pour the mixture on to a few pieces of granulated zinc: very pure nitrous oxide is slowly evolved:—

$$10HNO_3 + 4Zn_2 = 8ZnNO_3 + 5H_2O + N_2O.$$

Nitrate of zinc remains in the bottle. (3) Nitric acid. Perhaps the boys have noticed shopmen testing coins with liquid from a very small bottle. This liquid is nitric acid, or aquafortis, HNO_3. All the ordinary metals, with the exception of gold and platinum, are corroded by it, The acid is said to 'eat' into the metal. Drop a little on a shilling; a black liquid is formed, the nitrate of silver. Similarly on a sheet of copper we get a green liquid, the nitrate of copper.

Nitric acid is obtained by the action of sulphuric acid upon either nitrate of sodium, or nitrate of potassium, $NaNO_3$ or KNO_3. Place some of the latter, *i.e.*, ordinary saltpetre, in a glass retort. Pour upon it an equal weight of sulphuric acid. Apply a gentle heat. Let the neck of the retort dip into a flask kept cool by a stream of cold water. Nitric acid gas is evolved, and condensed into a yellowish liquid giving off fumes. Instead of condensing the gaseous acid, it may be conveyed to the unstoppered mouth of a bottle containing strong solution of ammonia, when the well-known fumes of nitrate of ammonia are formed. Compare this with the similar formation of chloride of ammonia.

LESSON XXVII.—AMMONIA.

Let the boys smell a weak solution of ammonia; then a piece of ammonia bought at the shops; then some 'smelling salts,' to get the scholars familiar with the pungent smell. Place six or eight small pieces of meat in as many test tubes, with a small quantity of quicklime. If these tubes be heated over the spirit lamp, and passed round the class, the boys will recognise the smell of ammonia. Write the formula NH_3 on the blackboard. Dip a piece of blue test-paper in an acid; it is turned red. Then dip the same into a solution of ammonia; the blue colour reappears. Compounds which turn blue test-papers red are acids; those which turn red litmus papers blue are alkalies. Acids and alkalies are said to neutralise each other. When an alkali combines with an acid it forms a 'salt.'

Ammonia is present in the air, in clays, in the sap of plants, and the flesh of animals; it is the chief part of guano, a manure, which is the droppings of a water-fowl. Ammonia was originally obtained from camels' dung, in Libya, West of Egypt, near a temple of Jupiter Ammon; hence the name. When animal or vegetable substances putrefy, they give off ammonia, which disperses into the atmosphere, and being very soluble in water, is brought down to the earth by the rain. While in the ground, this alkali, ammonia, finds certain acids—*e.g.*, carbonic acid, H_2CO_3—with which it combines to form certain salts of ammonia—*e.g.*, carbonate of ammonia (smelling-salts)—which form an important food for vegetables. In fact, ammonia, thus combined, furnishes the chief supply of nitrogen to the growing plant.

LESSONS XXVIII. AND XXIX.—AMMONIA.

Its preparation. Recapitulate the main facts of the last lesson. Write NH_3 on the blackboard. Repeat the experiment with the pieces of meat and quicklime. Substitute fresh peas for the meat. Thus demonstrate the presence of ammonia in animal and vegetable substances; it is given off when such bodies undergo decomposition. When horns, skin-chippings, feathers, hair (*Note:* all similar in composition) are burnt, ammonia is given off. The ammoniacal liquor thus obtained would, if re-distilled, give the 'spirits of hartshorn.' Repeat the description of the making of animal charcoal, or bone-black—*i.e.*, bones are burnt in closed chambers. A large quantity of ammoniacal liquor is given off during this operation. The gas-works, however, furnish the largest supply of ammonia. It is one of the many by-products of the distillation of coal. Ammonia is prepared in the following way:—Powder up some chloride of ammonium, or sal-ammoniac, NH_3HCl. Mix with it some slaked lime; about an equal part. The mixed substances, in a state of powder or of paste, are heated in a flask or retort. Ammonia gas is evolved. It should first pass through a Woulfe's bottle, to arrest, by deposition, moisture, etc.

$$2NH_4Cl + Ca(OH)_2 = CaCl_2 + 2OH_2 + 2NH_3.$$

Two such generating apparatus should be in operation. From one, collect the ammoniacal gas in a dry glass vessel, by upward displacement; and test its presence by introducing the vapour of hydrochloric acid, when the characteristic white fumes of chloride of ammonium are formed. From the other generator allow the escaping gas to pass into water, which instantly absorbs it, so soluble is ammonia in water. Test its presence here with red litmus paper. If there is time, other tests for ammoniacal vapour may be shown. Moisten three papers: (1) with subnitrate of mercury; (2) with sulphate of copper; (3) with chloride of manganese solution. The ammonia gas turns 1, black; 2, blue; 3, brown.

LESSON XXX.—AMMONIA.

Chief compounds:—1. Sal-ammoniac, or chloride of ammonium, NH_4Cl. Repeat the experiment with the dry fumes of ammonia and hydrochloric acid. Take this opportunity of recapitulating what has been said about synthesis and analysis. 2. Smelling-salts, or carbonate of ammonia. The combination of carbonic acid, H_2CO_3, with ammonia, gives us carbonate of ammonia. The ordinary carbonate of ammonia, or what at the shops is known simply as 'ammonia,' is really the sesquicarbonate of ammonium. But this form becomes converted into the more permanent carbonate by exposure to the air. A pretty experiment on crystallisation may here be performed. Powder up some of the commercial sesquicarbonate; pour on some boiling water, and let the solution slowly cool in a tightly corked flask. Large crystals (right prismatic system) of NH_4HCO_3 are obtained.

(*To be continued.*)

—o—

THE WATER-MILL.

T. CRAMPTON.

Andantino grazioso.
1st TREBLE.
2nd TREBLE.
BASS.
1. Lan-guid-ly (1) the au-tumn wind Stirs the for-est leaves; In the fields the reap-ers sing,
2. Au-tumn winds re-vive no more Leaves all sere and brown; Hook or (4) sic-kle can-not reap
3. Let us mark this les-son well— 'Tis a les-son true— Gold-en years are fleet-ing by,
KEY G. Andantino grazioso. p
D. t.
Bind-ing up the sheaves. Sooth-ing sounds the wa-ter-mill, Thro' the live-long day,—
Corn that's cut and down. From the wheel the stream flows on, (5) Ruf-fled, nev-er still;
Youth is pass-ing too: Learn to make the most of life, Lose no hap-py day;
f. G.
Clink-ing, clank-ing, how its wheel (2) Wears the hours a-way!
Nev-er glid-ing back a-gain (6) To the wa-ter-mill.
Time will nev-er bring us back Chan-ces pass'd a-way.
CHORUS.
Clink, (3) clank, clink, clank, While the stream flows
CHORUS.
The
on;..... Clink, clank, clink, clank, Till the work is done: Tru-ly speaks the pro-verb old,
stream flows on;
With a mean-ing vast— "The mill can nev-er, nev-er grind With wa-ter that's gone and past."

(1) Wave right hand very gently. (2) Move the right arm in a circle. (3) Beat the foot on the floor. (4) Pull the right hand briskly to the body, as in reaping. (5) Move the left arm gently to the left side. (6) Move the right arm to the right.

My Scholarship Answers.

BY H. D'ALBERTANSON.

First on the Scholarship List, 1884.

(Continued from page 504.)

16. What great changes have been made in the representation of the people in Parliament during the present century?

In 1801 the Irish Parliament was united to that of Great Britain, and Ireland sent 100 Commoners and 32 Peers to Westminster, but there was no reform in the representation of the people till 1832, when Lord John Russell succeeded, after having tried three times, in passing a Reform Bill. This bill provided that all boroughs with less than 2,000 inhabitants should be disfranchised, that all between 2,000 and 4,000 should return only one member, while many large towns as Birmingham, Leeds, Manchester, etc, were to return two members. The franchise was also extended, all paying a rent of £10 in towns, or £50 in the country, having a vote. Three years previously the Catholic Emancipation Bill had been passed, allowing Roman Catholics to become members. These reforms, however, were not great enough to satisfy a large mass of the working men, who had been led by political agitators to expect wonderful benefits: thus the Chartist Agitation broke out, and they demanded amongst other things, Universal Suffrage, Vote by Ballot, Payment of Members, Abolition of the Property Qualification, etc. In 1867 another Reform Bill was passed by the Derby and Disraeli ministry; by this bill the Franchise was still further extended: all paying poor rates, and all lodgers paying £10 rent in towns had a vote on condition of one year's residence, while in counties all paying £12 rent were enfranchised. Also Liverpool, Manchester, and one or two other large towns received the right of sending three members. Of the Chartists' demands two have since been granted, viz., Vote by Ballot and Abolition of the Property Qualification.

Penmanship.

Unquestionably.

The ploughman homeward plods his weary way,
And leaves the world to darkness, and to me.

Dictation.

As for the barbarian hordes of early ages, we hear indeed of their coming like a cloud from the east, and sweeping over Europe with the sudden destructiveness.

Grammar.

COMPOSITION.

Letter on 'The Best Way of Spending Holidays.'

Dear Harold,—

You ask me to give you some advice as to the best way of spending your holidays this summer. I think I can tell you of a capital plan, which I can recommend from experience.

I should advise you, first of all, to choose one of your best friends with whom you are thoroughly acquainted, and get him to spend his holidays with you: then select some pleasant country-town or watering-place to form, as it were, your base of operations, and procure comfortable lodgings. As soon as you get down there, buy a map of the district, or a guide-book, and note all the places of interest: then by taking a series of walking tours, lasting sometimes one, sometimes two days, all of these places may be visited. Be careful, however, always to take one or two days of rest between each long walk, so as not to tire yourselves too much. Last year I went with our friend W—— to Hastings, and we followed out the plan I have described. I do not think I ever spent a pleasanter holiday. We visited all the places of interest within about fifteen or twenty miles, including Battle, Pevensey, Hurstmonceux, Bodiam, Winchelsea, and several others, but at the same time took care not to do too much walking at a time, occasionally going short journeys by rail, and always spending one or two days at Hastings between each excursion; for after a good walk you enjoy a day on the beach or cliffs with a book and the evening concerts on the pier. I think that if you follow out my plan, you will spend a very happy holiday, and will not find it very expensive. Of course a trip up the Rhine, a visit to the Alpine Lakes, or to picturesque Italy would be very enjoyable, but I am afraid the expense would be too great to suit either your pocket or mine. With kind regards,

I remain,

Yours very sincerely,

HENRY D'ALBERTANSON.

1. Parse the words in italics in the following passage, not omitting to give and explain their syntax:—

I *met* a traveller, from an antique land,
Who said: Two vast and trunkless legs of stone
Stand in the desert. Near *them* on the sand,
Half-sunk, a shattered visage lies, *whose* frown
And wrinkled lip and sneer of cold command
Tell that the sculptor well those passions *read*
Which still survive, *stamped* on these lifeless things,
The hand *that* mocked them and the *heart* that *fed:*
And on the pedestal these words appear:—
'My name is Ozymandias, *king* of kings;'
Look on my works, ye mighty, and *despair!*
Nothing beside remains. *Round* the decay
Of *that* colossal wreck, *boundless* and bare,
The lone and level sands *stretch* far *away.*

Met—irreg. trans. verb, active voice, ind. past, sing., 1st per. agreeing with *I.*

who—rel. pro., com. gen., sing., 3rd, nom. to *said* and agreeing with antecedent *traveller.*

them—per. pro., neu. gen., plu., 3rd, obj. by prep. *to* (understood).

half-sunk—perfect participle of verb to 'half-sink.'

whose—rel. pro., neu., sing., 3rd, poss. case, possessing *frown.*

tell—reg. trans. verb, ind., present, plu., 3rd, agreeing with *frown, lip,* and *sneer.*

that—conjunction, joining two sentences.

read—irreg. trans. verb, act. voice, ind., past, sing., 3rd, agreeing with *sculptor.*

which—rel. pro., neu. gen., plu., 3rd, nom. to *survive*, and agreeing with its antecedent 'passions.'

stamped—perfect participle of verb 'to stamp.'

that—rel. pro., neu., sing., 3rd, nom. to *mocked*, and agreeing with its antecedent *hand.*

heart—com. noun, neu., sing., 3rd, obj. by *survive.*

fed—irreg. trans. verb, act. voice, ind., past, sing., 3rd, agreeing with *that.*

king—prop. noun, masc., sing., 3rd, nom., in apposition with *Ozymandias.*

despair—reg. intrans. verb, imp., present, plu., 2nd, agreeing with *ye mighty.*

nothing—abs. noun, neu., sing., 3rd, nom. to *remains.*

beside—preposition governing *things* (thus: Nothing beside these things remains.)

round—prep. governing *decay.*

that—demonstrative adj., pointing out *wreck.*

boundless—adj., qualifying *sands.*

stretch—reg. intrans. verb, ind., pres., plu., 3rd, agreeing with *sands.*

away—adverb, modifying verb *stretch.*

2. Analyse either the first or the last half of the passage opposite into its component sentences, showing: (*a*) nature of the sentence. (*b*) If dependent, its relation to principal. (*c*) Subject. (*d*) Its enlargement. (*e*) Predicate. (*f*) Its extension. (*g*) Object. (*h*) Its enlargement.

	SENTENCE.	(*a*)	(*b*)	(*c*)	(*d*)	(*e*)	(*f*)	(*g*)	(*h*)
1	I met a . . . land	Principal		I		met		a traveller	from an antique land
2	Who said	Subordinate	Adj. to 'traveller'	who		said			
3	Two vast and trunkless legs of stone . . . desert	Subordinate	Noun sentence to 2	legs	two. vast and trunkless. of stone	stand	in the desert (place)		
4	Near them on the sand . . . lies	Subordinate	Noun sentence to 2	visage	a shattered	lies	near them (place), on the sand (place), half-sunk (manner)		
5	Whose frown and wrinkled lip and sneer of cold command tell	Subordinate ,, ,,	Adj. to 'visage' in 4	frown, lip and sneer	whose wrinkled of cold command	tell			
6	That the sculptor . . . read	Subordinate	Noun sentence to 5	sculptor	the	read	well (manner)	passions	those
7	Which still survive . . . hand	Subordinate	Adj. to 'passions' in 6	which (passions)	stamped on these lifeless things	survive	still	hand	the
8	That mocked them	Subordinate	Adj. to 'hand' in 7	that (hand)		mocked		them	
9	And which still survive the heart	Subordinate	Adj. to 'passions' in 6	which		survive	still	heart	the
10	That fed	Subordinate	Adj. to 'heart' in 9	that (heart)		fed			

3. Explain by a paraphrase or otherwise the passage from 'near them' down to 'that fed.'

Near to these two legs of stone lies a shattered bust, half sunk in the sand, but on which may still be traced the frown, wrinkled lip, and stern coldness of command, as when sculptured from the living being whom they represent, showing that the sculptor had well understood those passions which still survive, stamped on those lifeless objects, both the artist and the person from whom he copied them.

4. Examine and illustrate the etymology of any five of the following words from the above sonnet:—Traveller, visage, passions, survive, despair, level, boundless, lone, decay, colossal, desert, lip, pedestal.

Pedestal, from Lat. pes, pedis, a foot; pedestrian.
Lip, from Anglo-Saxon lippa.
Colossal, from Lat. colossus, gigantic; Colosseum.
Passions, from Lat. patior, I suffer; patience, passive.
Visage, from Lat. videre, visum, to see; vision.

5. Show by definition and examples what is meant by (*a*) substantive, (*b*) intransitive, (*c*) passive, (*d*) defective, (*e*) strong or irregular, (*f*) weak or regular, verbs. To which of the two last-named classes would you refer the verbs—to lead, to spread, to show, to sweep, to spend; and why?

(*a*) The Substantive Verb is a verb that possesses all the qualities of a noun, as: 'His *coming* of age was attended with grand festivities;' 'Much *learning* hath made him mad.'

(*b*) The Intransitive Verb is one in which the action does not pass over from an agent or subject to an object, as: John *walks*; He *laughed*.

(*c*) The Passive Verb is the verb formed by the perfect participle of a transitive verb joined to the verb 'to be.' In such a verb the subject suffers the action, as: He *was taken* to the doctor's; William *was sent* home.

(*d*) The Defective Verb is one in which one or more of the tenses is wanting, as: Can, may, must, etc., which have no participles nor future tense.

(*e*) The Strong or Irregular Verb is one which does not require *d* nor *ed* to be added to the present tense to form the past tense or perfect participle, as, *sing*, *ring*, etc.

(*f*) A Weak or Regular Verb is one that requires *d* or *ed* to be added to the present tense to form the past tense or perfect participle. To lead, to spread, to sweep, to spend, are irregular, because neither *d* nor *ed* is added. 'To show' is either reg. or irreg., thus: Pres., show; past, showed; per. part., showed or shown.

It is sometimes said that the above verbs are regular, having been contracted, as from sweeped to swept.

6. Give your definition of an adverb, a preposition, and a conjunction, and show by examples the difference between each of them and the other two. Can you mention any words belonging to these three classes which cannot be parsed without knowing their position in a sentence?

An adverb is a word which modifies a verb, an adjective, or some other adverb. *A preposition* is a word showing the relation between two or more nouns or pronouns. *A conjunction* is a word which joins words, clauses, or sentences.

Examples:—1. All *but* John left the room. 2. It is *but* right that he should go. 3. He asked me, *but* I refused.

In Ex. 1 the word 'but' is a preposition, for it is followed by the noun 'John,' and shows how he stands in relation to 'all'—that is, the other people, while it has no connection with any verb, adjective, or adverb, and therefore is not an adverb; also it is clear that it does not join any words or sentences, and thus cannot be a conjunction.

In Ex. 2 'but' is not followed nor connected with any noun or pronoun, but modifies the adjective 'right,' taking the place of 'only'; it is therefore an adverb. It does not join anything, and therefore cannot be a conjunction.

In Ex. 3 we find the two sentences 'He asked' and 'I refused,' which are connected by the word 'but,' thus showing 'but' to be a conjunction. It is not followed by any noun or pronoun, and does not modify any verb, adverb, or adjective, and thus is neither an adverb nor a conjunction.

The following words cannot be parsed unless their position in the sentence is known:—But, only, up, down, as, except, etc.

7. Write a short historical sketch of the origin and growth of the English language, with dates.

The Celts were the first inhabitants of the country, and although their language was almost totally displaced by that of the Angles, Saxons, Jutes, etc., yet we still have some traces of their presence. As the first inhabitants, they gave names to

many physical features of the country as Aber and Inver = mouth of a river, as Aberdeen, Inverness; avon = water; ben = mountain; glen = a valley; mull, ross = a cape, etc. Also from those Celts who were reduced to slavery we have a few such words as kiln, basket, cradle, etc.

The Roman Influence.—The Romans occupied the country for about 400 years, having first come over in 55 B.C., and left about 410 A.D. The occupation, however, was military, and thus there was little intermingling between Romans and Britons. In our language we have but few traces of this occupation, the chief being from such words as castra, a camp, Chester; colonia, a colony, Lincoln; strata, a road, Stratford, street; pons, a bridge, Pontefract, etc. When St. Augustine came over nearly 200 years afterwards, the religion of the country gradually changed, and many fresh words, chiefly relating to ecclesiastical matters, were introduced, as monk, minister, apostle, cloister, epistle, etc.

Teutonic Element.—The foundation of our present language rests upon that of the Saxons who came over first in 449 A.D. Nearly the whole of our grammar is derived from them, and almost all of the most common nouns, verbs, and adjectives. In ordinary conversation and in the works of our best modern writers, words of Saxon origin far outnumber those derived from any other source. When the *Normans* came over in 1066 many fresh terms were introduced chiefly relating to war, hunting, feudalism, and law, as lance, venison, baron, plea, etc. Intercourse with the nations on the Continent brought about the introduction of many foreign words, and our language now consists principally of Saxon, French, Latin, Greek, and Celtic words.

French.

1. Translate into English :—

C'était le moment où le Portugal se livrait, dans un esprit de colonisation ou d'aventures, à des tentatives navales incessantes pour relier l'Europe à l'Asie, et où Vasco de Gama, le colon portugais, n'était pas loin de découvrir la route maritime des Indes par le Cap de Bonne-Esperance. Colomb, convaincu qu'il trouverait une route plus directe en s'élançant droit devant lui vers l'ouest, obtint, après de longues sollicitations, une audience du roi, pour lui révèler ses plans de découverte et pour lui demander les moyens de les accomplir.

This was the moment in which Portugal devoted herself in a spirit of colonisation or adventure to constant naval attempts to connect Europe with Asia, and in which Vasco de Gama, the Portuguese colonist, was not far from discovering the maritime route to the Indies by the Cape of Good Hope. Columbus, convinced that he could find a more direct route, in setting out straight before him towards the west, obtained, after many solicitations, an audience with the king, to reveal to him his plans of discovery, and to beg the means by which to accomplish them.

2. Parse fully the words où, ou, se, était, que, vers, du, incessantes, après, convaincu, trouverait, longues, obtint, découverte.

Où = in which (lit. where, an adverb), rel. pro., neut., sing., 3rd, agreeing with its antecedent 'moment.'

ou—a conjunction, joining 'de colonisation' and 'd'aventures.'

se = herself, per. pro., fem., sing., 3rd, obj. case by 'livrait.'

était—intrans. verb, ind., imperfect tense, sing., 3rd, agreeing with 'Vasco de Gama.'

que—a conjunction.

vers—a preposition governing 'l'ouest.'

du—a preposition governing 'roi.'

incessantes—an adjective qualifying 'tentatives.'

après—a preposition governing 'sollicitations.'

convaincu—past participle of 'convaincre.'

trouverait—trans. verb, cond., pres., sing., 3rd, agreeing with 'il.'

longues—adjective qualifying 'sollicitations.'

obtint—past participle of 'obtenir.'

découverte—com. noun, fem., sing., 3rd, obj: by 'de.'

3. Write out in full the principal tenses of the verbs in the last question.

Etre, to be.

PRESENT.	IMPERFECT.	PRETERITE.	FUTURE.
Je suis	J'étais	Je fus	Je serai
Tu es	Tu étais	Tu fus	Tu seras
Il est	Il etait	Il fut	Il sera
Nous sommes	Nous étions	Nous fumes	Nous serons
Vous êtes	Vous etiez	Vous futes	Vous serez
Ils sont	Ils etaient	Ils furent	Ils seront

Convaincre, to convince.

PRESENT.	IMPERFECT.	PRETERITE.	FUTURE.
Je Convaincs	Je convainquais	Je convainquis	Je convaincrai
Tu convaincs	Tu convainquais	Tu convainquis	Tu convaincras
Il convainc	Il convainquait	Il convainquit	Il convaincra
Nous convainquons	Nous convainquions	Nous convainquimes	Nous convaincrons
Vous convainquez	Vous convainquiez	Vous convainquites	Vous convaincrez
Ils convainquent	Ils convainquaient	Ils convainquirent	Ils convaincront

Trouver, to find.

PRESENT.	IMPERFECT.	PRETERITE.	FUTURE.
Je trouve	Je trouvais	Je trouvai	Je trouverai
Tu trouves	Tu trouvais	Tu trouvas	Tu trouveras
Il trouve	Il trouvait	Il trouva	Il trouvera
Nous trouvons	Nous trouvions	Nous trouvames	Nous trouverons
Vous trouvez	Vous trouviez	Vous trouvates	Vous trouverez
Ils trouvent	Ils trouvaient	Ils trouverent	Ils trouveront

4. Examine the construction in the following expressions :—'à des tentatives,' 'la route maritime des Indes,' 'en s'élançant droit devant lui,' 'pour lui demander les moyens de les accomplir,' 'après de longues sollicitations.'

'*a des tentatives*' means to some attempts; the word 'des' in this sentence means some.

'*la route maritime des Indes*' means the maritime route to the Indies. In this sentence the word 'des' means 'of the' (lit.); thus 'des' stands for 'some,' or for 'of the' before a plural noun. Observe that in both these sentences the noun is placed before its adjective, this being the common rule in French, although there are several exceptions.

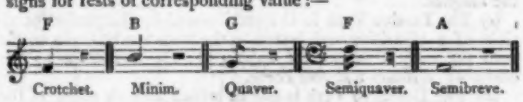
'*en s'élançant droit devant lui*' means in setting (himself) out straight before him; 's'élançant' is an example of a class of verbs peculiar to the French language, termed reflective, which are never used without the personal pronoun himself, herself, etc.—thus, 's'élançant' means himself setting out.

'*pour lui demander les moyens de les accomplir*' means 'for to ask of him the means to accomplish them.' The objective 'lui' is generally placed before the verb; 'de' seems superfluous, but the French use that preposition more often than the English.

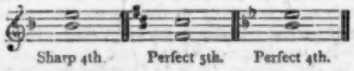
'*après de longues sollicitations*' means after many solicitations. 'De' here means 'some,' and takes the place of 'des,' which is not placed before an adjective in the plural number.

Music.

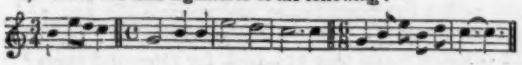
1. Write the pitch-names (C, B, &c.) and the duration-names (crotchet, minim, &c.) of the following notes, and write the signs for rests of corresponding value :—



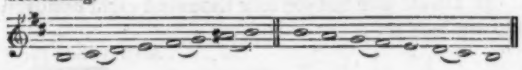
2. Describe the intervals (Major third, &c.) formed by the following pairs of notes :—



4. Write the time-signatures of the following :—



5. Write any form of the scale of B minor, ascending and descending.



Physiology.

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CHAPTER XII.—THE LYMPHATIC SYSTEM.

THE lymphatic system is a complicated arrangement of minute tubes and glands, which received its name from the character of the contained fluid (*lympha*, water).

It may be regarded from some standpoints as an adjunct of the vascular system, and its vessels commonly run in close relationship with blood capillaries. Indeed, it was formerly asserted that there was a distinct communication between the two. This is not, however, correct; the only direct conjunction is where the trunk lymphatic vessels empty into the large veins at the root of the neck.

An important subdivision of the lymphatic vessels are known as *lacteal* or *chyliferous* vessels, owing to the milky fluid (chyle) which they contain during the process of digestion. In all other respects lacteal vessels are identical with lymphatic vessels.

The larger lymphatic vessels resemble veins in structure, except that they are thinner, and their walls are almost transparent. They have three coats, and possess minute valves like veins, only more numerous. Their contents, the lymph and chyle, pass only in one direction, from the branches to the trunk vessels, and there is no circulation corresponding to that in the arteries. The greater part of the lymphatics empty into a duct (the *thoracic duct*), which is about eighteen to twenty inches long, and runs along the front of the spine to empty its contents into the point of junction of the left subclavian and jugular veins. Its largest size is about equal to that of a goose-quill. On the right side of the body there is a smaller duct, receiving the lymphatics from the right side of the head and the right arm.

In some part of their course all lymphatic vessels pass through certain bodies called *lymphatic glands*, which are to be found in nearly every part of the body. A poisoned wound in the hand commonly produces an inflamed lump in the armpit. This is owing to the poison having been absorbed by the lymphatics of the hand, and then been stopped by the lymphatic glands. If the quantity of poison is great an abscess of the gland may be produced.

Each lymphatic gland is covered by a capsule of connective tissue, from which processes, called *trabeculæ*, run into the interior of the gland, forming a supporting framework on which the essential structures of the gland are supported. This essential structure consists of a network of delicate retiform connective tissue, the interspaces of which contain lymph corpuscles. The meshes of lymphoid tissue thus formed are so arranged that at their outermost parts spaces are left, called *lymph channels*, or paths, along which the lymph travels. It is evident from this that the lymphatic vessel does not pass through the gland as such. In fact it becomes lost in the cortical part of the gland, its epithelium becoming continuous with that lining the lymph paths. The efferent vessel leaving the gland becomes continuous with the epithelium lining the lymph paths of the central part of the gland. It is evident from this description that the lymph washing its way through each lymphatic gland will acquire a considerable proportion of lymph corpuscles, the progenitors of the white corpuscles of the blood. Each lymphatic gland is abundantly supplied with blood-vessels.

The *origin of the lymphatic vessels* is various. The small capillary lymphatics, as a rule, form a *plexus or network*. This may be the ultimate origin, the fluid surrounding the plexus reaching its interior by osmosis. In the case of the lacteals, we have an instance of a second mode of origin, *i.e.*, in *blind, dilated extremity*. Very commonly a third mode of origin prevails, *in lacunar spaces* in the tissues, and this is doubtless a very prevalent method. The interstitial spaces of the various tissues are bathed with a lymph-like fluid, which has transuded from the blood-capillaries; these spaces are bounded by flattened epithelioid cells, which become continuous with the epithelium lining the minute lymph capillaries. Thus the commencement of the lymphatic system surrounds the blood-capillaries, and it may be described as *peri-vascular*.

Not only do the spaces between the various tissues form the beginnings of the lymphatic drainage system, but certain other better-defined spaces, and lined with a more complete epithelial layer, have a similar relationship to the lymph capillaries. An injection of milk into the peritoneal cavity is followed by a milky appearance of the lymphatics of the diaphragm, and it has been found that the milk escapes through minute openings or *stomata* formed between the epithelial cells of the serous membrane. Similar openings have been found in the pleura; and there can be no reasonable doubt that serous membranes in general constitute dilated commencements of the lymphatic vessels with which they are connected.

Lymph is usually clear, transparent, and if coloured at all, of a pale straw tint. In the larger lymphatic vessels it becomes more elaborated, corpuscles appearing in it. The fluid contains albumin and a considerable proportion of salts. As it approaches the thoracic duct, it becomes spontaneously coagulable, and must therefore contain the elements which go to produce fibrin.

The fluid contained in the lacteal vessels is during fasting lymph; during digestion its character changes, and it is known as chyle.

Chyle is a milky-looking liquid, the opacity of which is due to presence of very minute particles of fatty matter, averaging $\frac{1}{30000}$ of an inch in size. These constitute what is known as the *molecular base* of chyle. The fatty character of these particles is evidenced by their solubility in ether. As they do not run together to form globules, it is probable that each molecule is coated with a thin pellicle of albumin, just as are the fat granules of milk.

The fluid part of chyle contains albumin. After the chyle has passed through the lymphatic glands of

the abdomen, and approaches the thoracic duct, the molecular basis gradually diminishes, and is replaced by small corpuscles; while the chyle becomes spontaneously coagulable. The increase in coagulability seems to be in proportion to the number of corpuscles. The chyle and lymph corpuscles are practically identical with the white corpuscles of the blood.

It would appear that lymph and chyle contain, at any rate in the larger vessels, the same elements as are dissolved in the blood, only in smaller proportions. As regards the corpuscles, in the thoracic duct they show sometimes considerable advance towards development into red blood-corpuscles, intermediate varieties being visible under the microscope.

The lymphatic system thus has a double aspect. It serves to drain away the fluid which bathes all the tissues of the body, and to replace it in the blood-vessels from which it has escaped; and it serves as an important source of new blood corpuscles.

The quantity of chyle is somewhat doubtful. According to the results obtained by Bidder, the quantity of lymph daily passing along the thoracic duct appears to be about equal to the quantity of blood contained in the same animal. It would appear therefore that the whole of the liquid portion of the blood is daily replaced by lymph and chyle. As these, however, contain a much smaller proportion of solids than blood, the time required to replace the blood corpuscles must be longer; though the life of the red corpuscles is much shorter than might be at first imagined.

(To be continued.)

—o—

Recent Inspection Questions.

[*The Editor respectfully solicits contributions—all of which will be regarded as* STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

Arithmetic.

STANDARD I.

(*Nos. to be dictated.*)

(1) Addition:—738, 209, 98, 370, 876.
Ans. 2291.

(2) Subtraction:—310 − 85. Ans. 225.

(3) Subtraction:—509 from 608. Ans. 99.

STANDARD II.

(*Nos. to be dictated.*)

(1) Take 86,701 from 90,300. Ans. 3599.

(2) Divide 70,908 by 8. Ans. 8863 + 4.

(3) Multiply 29,567 by 805. Ans. 23,801,435.

STANDARD III.

(*A card.*)

(1) Take three hundred and seven pounds eleven shillings and a penny threefarthings from one thousand and one pounds two shillings and a halfpenny.

£1001 2s. 0½d. − £307 11s. 1¾d.
Ans. £693 10s. 10¾d.

(2) Add together £406 15s. 8½d.; £90,517 18s. 7¼d.; one hundred guineas; £73 9s. 10¾d.; and 600 pence. Ans. £91,105 14s. 2¼d.

(3) What change will be left in my pocket if I go out with a five-pound note and receive £2 12s. 7½d., but pay away £1 11s. 7d. for groceries, £1 19s. 9½d. for draperies, and £3 11s. 9½d. for rates and taxes?
Ans. 9s. 6d.

(4) Divide one million four thousand eight hundred and six by 532.
Ans. $1888\frac{320}{532}$.

STANDARD IV.

(*A card.*)

(1) In 5 ac. 3 roods 12 perches how many plots of ground each containing seventy square yards?
Ans. $402\frac{52}{70}$.

(2) Multiply fourteen pounds seventeen shillings and eightpence farthing by two hundred and twelve.
Ans. £3155 9s. 9d.

(3) Find how many steps of eighteen inches a girl would take in going from her home to school, a distance of one and a quarter miles. Ans. 4400 steps.

(4) A sum of £3155 18s. 7d. was divided among one hundred and six persons; how much would each receive? Ans. £29 15s. 5½d.

STANDARD V.

(*A card.*)

(1) Find the value of 37,209 articles at £6 11s. 7½d. each.

	£	s.	d.			
10s. = ½ of £1	37209	0	0	= value at £1 each.		
			6			
	223254	0	0	= „	£6	„
1s. = 1/10 of 10s.	18604	10	0	= „	10s.	„
6d. = ½ of 1s.	1860	9	0	= „	1s.	„
1½d. = ¼ of 6d.	930	4	6	= „	6d.	„
	232	11	1½	= „	1½d.	„
	£244881	14	7½	= „		
					£6 11s. 7½d.	„

(2) If for £3 11s. I can get 1 cwt. 2 qr. 10 lbs. carried a dozen miles, how far can I have 4 cwt. 3 qrs. 2 lbs. carried for the same money?

1 cwt. 2 qr. 10 lbs. = 178 lbs. 4 cwt. 3 qr. 2 lbs. = 534 lbs.

Distance that 178 lbs. can be carried = 12 miles
„ 1 lb. „ $= 12 \times 178$
„ 534 lbs. „ $= \frac{12 \times 178}{534}$

$$\frac{\overset{4}{\cancel{12}} \times \cancel{178}}{\underset{3}{\cancel{534}}} = 4 \text{ miles. Ans.}$$

(3) Find the fraction remaining after taking $2\frac{1}{2}$, $5\frac{2}{3}$, and $1\frac{1}{5}$ from 10.

$$10 - (2\tfrac{1}{2} + 5\tfrac{2}{3} + 1\tfrac{1}{5})$$
$$= 10 - \left(8\frac{15+20+6}{30}\right)$$
$$= 10 - 9\tfrac{11}{30}$$
$$= \tfrac{19}{30}. \text{ Ans.}$$

(4). Make out a bill, and settle it in proper form, for:—

160, Wadham Green,
15th Dec., 1883.

Messrs. Backhouse and Co.,
Bought of Jones and Brown.

	£	s.	d.
5 tons 3½ cwt. of lime at £1 10s. 10d. per ton	7	19	6¾
5,600 bricks at 32s. 6d. per 1000	9	2	0
700 firebricks at ¾d. each	2	3	9
75 deal boards, 15ft. by 6in., at 1½d. per sq. foot	3	10	0¾
Ans.	£22	15	7½

Received, same time,

£22 : 15 : 7½

Jones & Brown.

STANDARD VI.

(1) If 15 tons can be carried 7 miles for £4 10s., what weight can be carried 11 miles for £1 15s. at the same rate?

	Miles.		s. Tons.
Weight carried	7	for	90 = 15
" "	1	"	$1 = \frac{15 \times 7}{90}$
" "	11	"	$35 = \frac{15 \times 7 \times 35}{90 \times 11}$

$$\frac{\overset{5}{\cancel{15}} \times 7 \times \overset{7}{\cancel{35}}}{\underset{18}{\cancel{90}} \times 11} = \frac{24\frac{2}{3}}{6} = 3 \text{ tons } 14\tfrac{8}{33} \text{ cwt.} \quad \text{Ans.}$$

(2) Express the value of ·725 of a mile + 6·35 fur. − 1,212·575 yards as the dec. of a mile.

	yds.
·725 m. = ·725 × 1760 =	1276
6·35 fur. = 6·35 × 220 =	1397
	2673
1212·575 yds. =	1212·575
	1460·425

$$\frac{1460 \cdot 425}{1760} = \cdot 83978+. \quad \text{Ans.}$$

(3) What will the interest of £625 10s. amount to in 100 days at 6 per cent. per annum?

$$\frac{625\frac{1}{2} \times 6 \times 100}{100 \times 365} = £10\ 5\text{s. } 7\tfrac{53}{73}\text{d.} \quad \text{Ans.}$$

(4) A girl and her mother could do a piece of work in 12 days, and the mother could do it alone in 16 days. How soon could the girl alone finish it?

Work of mother and daughter in 1 day = $\frac{1}{12}$
" " alone in 1 day = $\frac{1}{16}$
" daughter " in 1 day = $\frac{1}{12} - \frac{1}{16}$

$$= \frac{4-3}{48} = \frac{1}{48}$$

Time for girl to do the whole work
= 48 days. Ans.

STANDARD VII.

(*A card.*)

(1) If by selling an umbrella for 6s. 9d. a draper gains 8 per cent., for what must he sell it if he wishes to gain 12 per cent.?

First selling price = 100 + 8 = 108
Second " = 100 + 12 = 112

108 : 112 :: 6s. 9d. : Req. S.P.
= 27 : 28 :: 81
= 1 : 28 :: 3
= 28 × 3 = 84d. = 7s. Ans.

(2) How much business must an agent do in order that his commission at 2¾ per cent. may amount to £87 18s. 2d.?

Business to gain	£2¾ = £100
" "	£1 = $\frac{100}{2\frac{3}{4}}$
" "	£87 18s. 2d. = $\frac{100 \times £87\ 18\text{s. } 2\text{d.}}{2\frac{3}{4}}$

$$\frac{400 \times \overset{7}{\cancel{87}} : \overset{19}{\cancel{18}} : \overset{10}{\cancel{2}}}{\underset{11}{\cancel{4}}} = £3196\ 13\text{s. } 4\text{d.} \quad \text{Ans.}$$

(3) Divide £153 19s. 4d. among three persons, giving the second 5 per cent. more, and the third 7 per cent. less than the first.

The shares will be: First, 100; second, 105; third, 93. Total = 298.

		£	s.	d.		£	s.	d.	
First	298 : 100 ::	153	19	4 :		51	13	4	Ans.
Second	298 : 105 ::	153	19	4 :		54	5	0	Ans.
Third	298 : 93 ::	153	19	4 :		48	1	0	Ans.

(4) What is the difference between banker's discount and true discount on a bill for £464, payable 10 months hence, at 3½ per cent. per annum?

$$\text{Banker's dis.} = \frac{\overset{116}{\cancel{464}} \times 3\frac{1}{4} \times \overset{5}{\cancel{10}}}{\underset{10}{\cancel{100}} \times \underset{3}{\cancel{12}}} = £12\ 11\text{s. } 4\text{d.}$$

Int. of £100 for 10 mos. @ $3\frac{1}{4} = \frac{\overset{5}{\cancel{10}}}{12}$ of $\frac{13}{\underset{2}{\cancel{4}}} = \frac{65}{24}$

£ £ £
$100\frac{65}{24}$: 464 :: $\frac{65}{24}$: T. D.

$$= \frac{\overset{1}{\cancel{24}}}{\underset{493}{\cancel{2465}}} \times \frac{\overset{16}{\cancel{464}}}{1} \times \frac{\overset{13}{\cancel{65}}}{\underset{17}{\cancel{24}}}$$

$$= \frac{208}{17} = £12\ 4\text{s. } 8\tfrac{8}{17}\text{d.}$$

Diff. = £12 11s. 4d. − £12 4s. $8\frac{8}{17}$d.
= 6s. $7\frac{9}{17}$d. Ans.

'Practical Teacher' Prize Story.

A TALE OF TWO SCHOOLS.

BY NOVICE.

(*Founded on Dr. Carpenter's 'Health at School.'*)

(*Continued from p. 521.*)

Besides the attendant, the two masters—for the committee of the voluntary school had united with the Board in this scheme—were constantly to be seen encouraging their boys.

The boys who learnt to swim were rewarded with a certificate, which they highly valued. The children were never allowed to stand about after undressing nor after bathing, when they rubbed themselves well all over with a rough towel. These the children provided themselves, and it was a punishable offence to leave the bath with wet hair.

We will not stop to describe the swimming races at the end of the season. We should like to attempt that between the two schools, for instance, when, as with the cricket, there was the same eager struggling for the first place.

Prizes were given, in the same year as the events recorded in the last chapter, at a public meeting. After the distribution, at which friends from both schools were well represented, the chairman, who was the chairman of Mr. Henton's committee, presented him with a very beautiful timepiece, on behalf of the scholars, teachers, and committee. After which the Chairman of the School Board said that he had a like pleasant duty to perform on behalf of the Board, teachers, and scholars, in presenting a writing-desk to Miss Danford.

Within a month these two personages had bidden adieu to Mr. and Mrs. Stafford and all their friends, and had gone to open a boarding-school in a town in one of the metropolitan counties.

CHAPTER IX.—THE LAST.

MRS. HENTON, *née* Alice Danford, was now to help her husband in the new undertaking. We will not describe the building in which Mrs. Henton, who had lately had a considerable sum of money left him by his uncle, had taken every pains to ensure those things so necessary to the health of his scholars.

We must, however, say a few words about the care of his dormitories, which part of the building is frequently not properly cared for.

The younger boys were to be accommodated with large open sleeping apartments, with beds in each apartment for twelve children. The elders were to have their rooms divided into cubicles; the partitions being made of wood, and so arranged that they were nowhere, except at their supports, touching the floor. They were sliding partitions, and could be removed altogether, if necessary.

The utmost care was taken that the rooms should be ventilated day and night, and in the winter they were slightly warmed.

In the middle of the rooms, the whole of the washing-basins were arranged, one to each boy.

No visiting in cubicles was permitted on any account. In fact, so stringent were the rules, that one boy who had disobeyed three times, after repeated caution, had been immediately expelled.

Mrs. Henton performed her part in seeing that the servants kept the bedrooms perfectly clean. She was also most careful in superintending the purchase, and also the cooking, of all the food, knowing that in such a school, all the care taken to ventilate, warm, and in other ways care for the health of the body, would be altogether unsuccessful without the body being well built up by proper nourishment.

Mr. Henton was most successful in his new school, assisted by his amiable and affectionate wife. Constant correspondence was kept up with the Staffords, and it was generally arranged that the two families, numbering a few more heads than formerly, should spend their vacations together.

Both masters earned the love and respect of their pupils and their parents, and hope to be able to retire in their old age to the pretty little town of Dawlish, in which they have spent many a happy hour together—in which wish we most heartily join.

THE END.

Article 106 (*b*).

Merit Grant in Infant Schools.

BY MRS. MORTIMER,

Lecturer on Kinder-garten at the Home and Colonial Training College, London.

Section II.—Phenomena of Nature.

LESSON—THE AUTUMN.

WE have already spoken about two parts of the year. Can you tell me what they are? The Spring and the Summer. How many parts have we still to talk about? Two. What are they? The Autumn and the Winter. We have one name for all these parts; do you know what it is? Yes, we call them the Seasons. How many Seasons are there? Four. What are their names? Spring, Summer, Autumn, and Winter.

Now, you can tell me some of the work that is done in the Spring—what kind of weather we have—the flowers that grow, etc. Then you can also tell me about the Summer—the nice warm weather and long days—the bright sunshine—the lovely flowers, and the fruit, etc. Then the next season is called Autumn, and I want you to try to tell me what goes on then, the flowers that grow, and the kind of weather we have.

Do you remember the hot weather we have in the Summer, and the very long days, and how you liked playing in the garden, and did not go to bed till it was very late? Well, when the Autumn comes the days begin to get much shorter, and I daresay you will notice that it is too dark to play out-of-doors in the evening, and so you go to bed earlier. Do you mind that? No, because we cannot see to play, and we can go to sleep when it is dark. What do you notice about your clothes? Our mothers are careful to wrap us up well when we go out. Why? Because the weather is much colder, and we might catch cold if we were not well wrapped up.

How did you say the gardens looked in the summer? Very bright and pretty. Why? Because they were full of lovely flowers. What else did you notice in the gardens? The birds singing, the bees flying about from flower to flower, and butterflies, and many other things. Then the air is filled with the scent of the pretty flowers. Yes, that is quite right. In the Autumn, however, you will not find the butterfly and bee. Do you know why? Because the weather is cold. Then most of the bright flowers have died, especially after the first part of the Autumn has gone. We still have a few flowers left. Can you tell me the names of any? Asters, dahlias, and chrysanthemums. Yes, the chrysanthemums are the real Autumn flowers, and remain a long time in the garden. And now, I want you to tell me about the fruit. You remember that in early summer we had strawberries, gooseberries, raspberries, etc., and later we had cherries, and some apples and pears. Can you tell me what we have in the Autumn? Apples, pears, and oranges. Where have you seen the oranges growing? That is right; we cannot see them in our gardens for they grow in a warmer country. They are sent to us from countries that are very much hotter than ours, and they come a long way. Do you know how they are brought to this country? They are packed in large boxes, and brought across the sea in ships.

Now, I want some of you to tell me the work that is done at this time of the year. The harvest is finished. Do you know the names of some of the things that are gathered at this time? Yes, apples and pears. And what else? Corn and hops. You will see the men very busy ploughing the ground, and sowing seeds for next year's crops.

Then if we stay with the farmer we shall find him very busy threshing the corn. Can you tell me what that means? Why do they thresh corn?

The summary should consist of the names of the dif-

ferent flowers and fruits that grow in the Autumn, and of the different work done by the farmer and gardener at this time of the year.

Section III.—Scenes of Common Life.

LESSON—MEANS OF WARMING AND LIGHTING.

(A) *Means of Warming.*—Now, children, will you tell me what kind of weather we have in the summer? And in the winter? How do you often feel in the winter? Do you like feeling cold? What do you do to warm yourselves? Run about and play at games that make us move quickly. Do you run about the house to keep warm? What do we have in our houses to keep us warm? Fires. Do we have fires in the summer-time? Yes, in the kitchen. Why? To cook our food. But do we have a fire in the sitting-room? Why not? Because it is quite warm enough without a fire. How is that? The sun is so hot and shines so brightly, that it makes all the rooms warm. Then we have found out that the sun keeps us warm in the summer, but in the winter we are obliged to have fires to make us warm.

When you are in the schoolroom in the winter, do you feel cold? How is that? Are there any fires in your school? Well, I wonder how the room is warmed. Well, Mary, what do you say? There are a great many hot pipes in the room. Whereabouts are these pipes? All round the room, under the floor, and down the walls. How do you know they are hot? I have put my hands on them. Yes. I often see little boys and girls putting their hands on the pipes, and sometimes I see the boys putting their feet on them. Why do they do this? To make their hands and feet warm. Do you know what makes the pipes hot? Well, listen, and I will tell you. There is a very large fire making the water very hot, and this hot water runs through the pipes and makes them hot. By the time the water has been through the pipes it is cold and fresh hot water goes into them, and in this way the pipes are kept warm. The caretaker only has one large fire to see to, and he has not the trouble of clearing away a great deal of ashes from the fire-grates like your mother has to do at home. Harry says that he knows a school where they have very large fire-grates. Well, this is not as nice as the pipes. Can you tell me why? In our large room it does not matter where you sit, you will find it warm, but in the large rooms warmed by the fire-grates, the children who sit near are very warm, and the children who sit at the other end of the room will be very cold, although there is a large fire in it.

If any of the children should have seen the steam warming apparatus, the teacher might explain that steam is passed into the pipes from a large boiler instead of water. A simple experiment might be made before the children by means of a spirit lamp, kettle, and piece of metal tubing.

Now, you can tell me two ways of warming our rooms. What are they? Fire-grates or open fires, and hot-water pipes.

How many of you have been to church? Do you feel cold there? What makes the church warm? Yes, there is a fire there, but is it an open fire like ours at home? No, it is a large stove. These stoves are very useful for warming large rooms. They throw out a great deal of heat. Very often in churches you see the gas burning, even in the morning. Do you know why the gas is alight? To give us light. Do we want the gaslight when the daylight is good? The gas is lighted to help to warm the church. Well, John, what do you want to say? The school I used to go to had large stoves in the rooms. Oh, yes. Stoves are also used to warm many other places besides churches and schoolrooms.

Sometimes people have gas stoves to warm their rooms; that is, they burn gas always instead of fires. Some of these stoves look very pretty, and when alight, look like the open fire. They are very clean. What does your mother have to do after there has been a fire? She has to clear away the ashes, and clean the grate. With a gas stove she would only have to turn out the gas; there would be no dust or dirt. Then, when she wants a fire she would not have to carry coals about, or paper and wood. She would only have to light the gas. You see, then, that this is another way to warm the rooms.

Sometimes rooms are warmed in the following way by means of hot air. A large furnace, with a shaft leading up to the room is built in the cellar, or at the bottom of the building. What do you mean by a furnace? What is a shaft? The teacher should sketch this on the blackboard, and then point out that a grating is put into the shaft leading into the room, and that this grating can be opened or closed whenever the teacher wishes, and explain why. A very large fire is made in the furnace, and the air passing over it is made very hot, and then goes up the shaft. Where does the shaft lead to? What comes through the grating? How does this warm the room? You will notice on the other side of the room another grating, and if you put your hand there you will not find hot air. This grating lets the air out after it has passed through the room. You see, then, that this is something like the hot-water pipes. The hot water runs through the pipes, and when cold, passes out. The hot air passes through the room, and leaves it at the other end. If you put your hand, or even stand near the grating in the shaft, you will feel the hot air rushing into the room. This way of warming the room keeps every part of the room warm.

Now, I want you to think about what we have been talking; and tell me the different ways of warming the rooms, etc.

We warm rooms by means of open fires or grates.
We warm rooms by means of closed fires or stoves.
We warm rooms by passing hot water through pipes.
We warm rooms by passing steam through pipes.
We warm rooms by means of gas in gas stoves.
We warm rooms by means of hot air.

(B) *Means of Lighting.*—Now I want you to think about something else. When it gets dark what must we do if we want to see? We must get a light. What kind of light do we get? Well, one little girl says her mother lights the gas, and another says her mother lights the lamp, and here is a little boy who says his mother lights a candle. So you see there are several ways of getting light. Tell me them again. The gas, the lamp, and the candle. We will have a talk about each of them.

How does your mother light the gas? Yes, she turns on a little tap, and then lights it. With what does she light the gas? With matches or a piece of lighted paper. Does your mother have to put anything in the tap? Can you see the gas before it is lighted? How, then, do you know when it is turned on? That is right, you can smell it. Can you smell it when it is alight? No, there is no smell when it is alight. But there is another way you can tell when the gas is turned on. Can you tell me? Yes you can hear it. Do you know that you should never touch the gas pipes? Why? Well, I will tell you. If the gas is turned on without being lighted, the gas keeps on coming out of the pipe, and the room gets quite full of gas. Then if any one goes into the room with a light the gas would catch fire, and there would be an explosion. Have you ever heard of an explosion? What does it do? The teacher might here relate a short account of a gas explosion, showing the damage done, etc. What kind of light do we say the gas gives? A nice bright light. What must you remember about the gas? That it is very dangerous, and we must not touch the pipes. If ever you smell gas what should you do directly? Tell mother, so that she can see to it. Yes, sometimes there is a very small hole in the pipe, and the gas comes out or escapes. Your father must then stop up the hole or call the gasfitter to it.

Now I should like you to tell me something about the lamp. How many of you have lamps at home? What does your mother put into the lamp? Oil. What oil

does she use? What else is in the lamp? The wick. Of what is the wick made? Which part of the lamp does your mother light? The wick. Now you must also be very careful with the lamps, for if you knock the mover they are very dangerous; the oil quickly catches light, and it is very difficult to put out, and even if the oil did not burn it would spoil whatever things it fell upon. Which do you think your mother likes, the gas or the lamp? Why? Because the gas is easily lighted, and is no trouble. And the lamp? The lamp has to be cleaned and filled with oil every day. There is another kind of lamp in which we do not burn oil. Do you know what we put in them? Yes, spirit. Do you know the name of the spirit? Ah, Harry knows, because he says he fetches it for his mother. Look, I will write it on the board; you see it is a very long word for you: meth-y-lat-ed spir-it. For what does your mother use these lamps? For carrying about the house, etc.

We have still one light to talk about. What is it? The candle. Of what is the candle made? Of tallow, and a wick in the middle. What use is the wick? Of what use is the tallow? In what do we stand the candle? Why? Do we get as much light from the candle as we do from the gas or lamp? Why does not your mother like you to carry the candle? Because we drop the grease about the house.

Then there is another light you have not told me about, and perhaps many of you have not seen it. If you go to some of the railway stations you can see it. It is also to be seen in large shops, and also in some of the streets. I mean the electric light. Hands up those of you who have seen this light. What kind of light is it? It is very, very bright, and looks very nice. You shall learn more about this another day.

Section IV.—Common Employments.

LESSON—THE ERRAND BOY.

We are going this morning to talk about the errand-boy, and I want you to tell me all you can about him. What work do errand-boys have to do? They have to take messages, parcels, and letters for their masters. What do they do when they are not thus running about? Who has seen an errand-boy busy in the shop? Well, tell me some of the things he was doing. Yes, he has to sweep and dust the shop, clean the windows, etc., light the fires, and some of them have to clean knives and boots, etc. Then the big ones take the shutters down and open the shop. So you see they have to get up early in the morning, and they generally have to put the shutters up at night. The duties of errand-boys should be carefully recapitulated before proceeding with the lesson.

Now, children, how many of you would like to be errand-boys when you are big enough? Very well, then, we will see what kind of boys you must be, in order to make good and useful errand-boys. Let us see what is the first thing the errand-boy has to do. He has to take messages and parcels. When his master is giving him a message, what should he be doing? Listening. Yes, and very attentively. It would not do for him to be looking at, or thinking about anything else. Why? Because if he did not hear the message properly, he would probably make mistakes when he delivered it, and this might cause a great deal of trouble. So we say, 'An errand-boy must attend to what is said to him.'

Again, perhaps the errand-boy might have several messages and parcels to deliver, and his master would then write the addresses on the parcels. Then what must the boy be able to do, so as to leave the right parcel at the right house? He must be able to read. Very often he would receive money for the goods, and then what would he have to do? He would have to write 'Paid,' and also his name on the bill. You see, then, that errand-boys must be able to read and write. Then while you are at school, if you want to be errand-boys, what must you learn to do? We must learn to read and write. Yes, you must work very hard while you are at school, for you will have but little time or chance afterwards.

When the boy has started on his errands, what should he do? He should go quickly to the places he has to call at, and return as soon as possible. Who has ever seen a boy going on an errand? Very well, Mary, what did you see him doing? He was carrying a parcel, and going along very quickly. Was that the right thing to do? Yes. Well, John, what have you to say? I saw a boy who had put his basket down, and was playing at marbles with some other boys. Was that right? Why? Because he was playing when he ought to have been working. Yes, and very likely the people to whom he was going were waiting for the things he had for them. What do you think his master would say if he saw him doing such a thing? He would be very angry, and very likely he would not keep him as his errand-boy, and so the boy would lose his place. The class should then repeat, 'An errand-boy should go quickly when sent on an errand.'

If a master wants an errand-boy, do you know what he does? Yes, he puts a card in the window with the words 'Errand-boy wanted' printed on it. Boys read the card, and if they want work they go into the shop to see if the master will have them. Now which of the two following boys do you think a master would choose? One has very clean hands and face, his boots well polished, and his clothes, though perhaps not new, nicely brushed. The other has dirty hands and face, his clothes very untidy, and his boots not blacked. The first one. Why? Yes, we do not like to see a dirty, untidy boy about the house. The children should then repeat, 'An errand-boy should be clean and tidy.'

Suppose a boy had to take a very nice cake to a house, but going along, he thought he should like a cake like that to take home with him, and then, instead of leaving it at the proper place, he takes it home. What do you think the lady would do who expected the cake? She would go to the shopkeeper and tell him that she had not received the cake. What would the shopkeeper then do? He would call the errand-boy and question him about it. Perhaps the errand-boy would say that he had left it at the house. What would this be doing? Telling a story. And what had he done when he took the cake home? He had stolen it. Do you think the boy would keep his place? No, the master would soon find him out. Yes, and then he would lose his situation, and what is worse still, he would find it very difficult to get another one. Do you know way? When a master takes a new errand-boy he generally wants what is called a character, and, therefore, he asks the boy's last employer all about him. The children should then repeat, 'An errand-boy should be truthful and honest.'

The teacher, proceeding in a similar manner, should show the necessity of errand-boys being respectful, obliging, obedient, and industrious, and also how unpleasant it is to have to deal with boys who do not possess these qualities, and how pleasant it is to work with good, happy, industrious boys.

As a recapitulatory exercise, the children might write the following on their slates, or repeat from blackboard:—

An errand-boy has to take messages, parcels, and letters.

He has also to sweep and dust the shop, clean the windows, etc.

Sometimes he has to clean boots, light the fires, and open and shut the shop.

An errand-boy must be able to read and write.

He must be attentive, active, clean, truthful, and honest.

(To be continued.)

ANSWERS TO
Pupil Teachers' Examination Papers.
FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Add together $\frac{5}{6}$ of 7, $\frac{4}{7}$ of 8, $\frac{7}{8}$ of 9, and $\frac{5}{9}$ of 10, and say what fraction of $37\frac{37}{37}$ is $27\frac{27}{37}$.

(*a*) $\frac{5}{6}$ of $7+\frac{4}{7}$ of $8+\frac{7}{8}$ of $9+\frac{5}{9}$ of 10

$= \frac{5\cdot5}{6\cdot5}+\frac{4\cdot6}{7\cdot6}+\frac{7\cdot9}{8\cdot9}+\frac{5\cdot10}{9\cdot10}$

$= 5\frac{5}{6}+6\frac{6}{7}+7\frac{7}{8}+8\frac{5}{9}$

$= 26\frac{420+432+441+448}{504}$

$= 26\frac{1741}{504}$.

$= 29\frac{493}{504}$. Ans.

(*b*) $\frac{27\frac{27}{37}}{37\frac{37}{37}}$

$= \frac{\frac{1000}{37}}{\frac{1000}{37}}$

$= \frac{27}{37}$. Ans.

2. If £1 is worth 25·3 francs, find the value of £4 7s. 6d. in French money.

£4 7s. 6d. = £4⅜ = £4·375

Since £1 = 25·3 francs

£4·375 = 25·3 × 4·375

= 110·6875 francs. Ans.

3. Which is the greater, and by how much, ·0475 of a guinea or ·325 of half-a-crown?

·0475 of a guinea = ·0475

21

475

950

s. ·9975

12

d. 11·9700

·325 of half-a-crown = ·325

30

d. 9·750

d. 11·97 − 9·75d. = 2·22d.

∴ ·0475 of a guinea is the greater by 2·22d. Ans.

4. A can reap $\frac{1}{6}$ of a field in $2\frac{2}{3}$ days, and B can reap $\frac{2}{9}$ of it in $4\frac{1}{2}$ days. In what time could A and B reap the whole field if working together?

A can do $\frac{1}{6}$ in $2\frac{2}{3}$ days

∴ „ $\frac{1}{9}$ in $\frac{2\frac{2}{3}}{4}$ „

„ $\frac{6}{9}$ in $\frac{2\frac{2}{3}\times9}{4}=6$ days.

B can do $\frac{2}{9}$ in $4\frac{1}{2}$ days.

∴ „ $\frac{1}{9}$ in $\frac{4\frac{1}{2}}{3}$ „

„ $\frac{5}{9}$ in $\frac{4\frac{1}{2}\times5}{3}=7\frac{1}{2}$ days.

A can do $\frac{1}{6}$ in 1 day.

B „ $\frac{1}{7\frac{1}{2}}$ or $\frac{2}{15}$ in 1 day.

A + B can do $\frac{1}{6}+\frac{2}{15}=\frac{5+4}{30}=\frac{9}{30}=\frac{3}{10}$ in 1 day.

Time for A and B to do $\frac{3}{10}=1$

„ „ $\frac{1}{10}=\frac{1}{3}$

„ „ $\frac{10}{10}=\frac{10\times1}{3}=3\frac{1}{3}$ days. Ans.

FEMALES.

1. Find by practice how much the assets of a bankrupt amount to if his debts are £9,285, and he can pay 17s. 11½d. per £.

9,285 @ 17s. 11½d. each.

	£	s.	d.			
10s. = ½ of £	9285	0	0	= Amount at	£1	per £.
5s. = ¼ of 10s.	4642	10	0	= „	10s.	„
2s. 6d. = ¼ of 5s.	2321	5	0	= „	5s.	„
5d. = ½ of 2s. 6d.	1160	12	6	= „	2s. 6d.	„
½d. = 1/10 of 5d.	193	8	9	= „	5d.	„
	19	6	10½	= „	½d.	„
	£8337	3	1½	= „	17s. 11½d.	per £.

2. A farmer left his children a sum of money which was the least number of pounds that could be divided by 24, 27, 28, 32, 36, and 56. Find the sum.

Amt. left = L.C.M. of 24, 27, 28, 32, 36, 56.

4	24, 27, 28, 32, 36, 56
2	6, 27, 7, 8, 9, 14
	3, 27, 4, 7

L.C.M. = 4 × 2 × 27 × 4 × 7 = 6048

£6,048 = sum left. Ans.

3. Simplify $\frac{1}{3\frac{1}{3}}-\frac{2\frac{1}{2}}{9}+\frac{3\frac{3}{8}}{2}+\frac{\frac{3}{4}}{4\frac{1}{2}}$.

$\frac{1}{3\frac{1}{3}}-\frac{2\frac{1}{2}}{9}+\frac{3\frac{3}{8}}{2}+\frac{\frac{3}{4}}{4\frac{1}{2}}$

$= \frac{3}{10}-\frac{1}{4}+\frac{27}{16}+\frac{1}{6}$

$= \frac{5-4+29+2}{16}$

$= \frac{32}{16}$

$= 2$. Ans.

4. Make out in proper form a bill for—

21½ lbs. of bacon at 10½d. per lb.
13 „ ham at 11d. per lb.
8¼ „ cheese at 1s. 1½d. per lb.
3½ doz. eggs at 7 for 6d.
¼ cwt. of rice at £1 13s. 3d. per cwt.
and 4½ stones of currants at 3d. per lb.

Civil Service Supply Stores,
London, S.W., 15th Jan., 1885.

Mrs. Morton.

Bought of CIVIL SERVICE SUPPLY CO., LIMITED.

	£	s.	d
21½ lbs. of bacon at 10½d. per lb.	0	18	9¾
13 „ ham at 11d. per lb.	0	11	11
8¼ „ cheese at 1s. 1½d. per lb.	0	9	6¾
3½ doz. eggs at 7 for 6d.	0	3	0
¼ cwt. rice at £1 13s. 3d. per cwt.	0	8	3¾
4½ stones currants at 3d. per lb.	0	15	9
	£3	7	4½

Received same time
J. Low,
For C. S. S. CO. LIM.

Grammar.

MALES AND FEMALES.

1. Parse the following sentence:—

'Why did you not do what I bade you?'

Why—an interrog. adv., qual. *did do.*
did—aux. verb to 'do,' irreg. trans., indicating past tense and completing neg. form of verb.
you—pers. pro., com. gen., plur. num., 2nd pers., nom. to *did do.*
not—adv. of mood (negation), qualifying *did do.*
do—irreg. trans. verb, act., inf., pres., gov. by *did.*
did do—irreg. trans. verb, act., ind., past, plur., 2nd, agreeing with its nom. *you.*
what—comp. rel. pro., = that which; *that*—neut., 3rd, sing., obj., gov. by *did do*; *which*—neut., 3rd, sing., obj., gov. by *to do*, und.
I—pers. pro., com. gen., 1st sing., nom. to *bade.*
bade—irreg trans. verb, act., ind., past, 1st, sing., agreeing with its nom. *I.*
you—pers. pro., com. gen., 2nd, plur., obj., gov. by *bade.*

2. What is an affix? Give as many affixes as you can which are used in forming English nouns, with examples.

An affix is a syllable added after a root, as bond—bond-*age.*

The principal affixes used in forming English nouns are:—

-Ar, as beg-g-ar; *-er*, read-er; *or*, sail-or; *-yer* or *ier*, saw-yer, cloth-ier; *-en*, vix-en; *-ard* or *art*, as lag-g-ard, brag-g-art; *-ster*, song-ster; *-dom*, king-dom; *-ship*, friend-ship; *-hood*, girl-hood; *-ness*, dark-ness; *-th*, steal-th; *-y*, beggar-y; *-ery*, mock-ery; *-ric*, bishop-ric; *-lock*, wed-lock; *-ledge*, know-ledge; *-ing*, read-ing.

3. Analyse the following lines:—

Come to the sunset tree!
The day is past and gone;
The woodman's axe lies free,
And the reaper's work is done.

SUBJECT.	PREDICATE.	OBJECT.	EXTENSION.
[Thou]	come	...	to the sunset tree (place)
The day	is past	...	
(and) [it]	[is] gone	...	
The woodman's axe	lies	...	free (manner)
(and) the reaper's work	is done	...	

4. What is a relative pronoun?

Give examples and sentences in which they are used.

A relative pronoun is one which not only stands for a noun, but relates to some noun or pronoun already used, and which is called its antecedent.

The relative pronouns are *who*, *which*, *what*, and *that*, and their compounds.

Examples: That is the man who called you.
I saw the house which you built.
The horse that I bought has broken its leg.
Ask him what he wants.

Geography.

(*Answer Q. 1 or Q. 2; not both.*)

1. Draw a map of Australia, marking the chief physical features only.

2. Describe the mountain system of Scotland.

Scotland is divided into the Highlands and Lowlands. The Highlands may be divided into two divisions, the Northern Highlands and the Grampians. The former lie N. and W. of a line drawn from the Moray Firth to the Firth of Lorne through Glenmore, Ben Attow, Ben Wyvis, and Ben More being the chief heights. The Grampians lie E. of this line, and have Ben Nevis, Macdhui, Cairngorm, and Cairntoul as the principal heights.

A second line drawn from Arran in the W. to Buchan Ness in the N. Sea may be said to divide the Grampians from the Lowlands. South of this line are the Ochil and Sidlaw Hills, near the Tay, the Campsie Fells near the Forth and Clyde, and the Lowther, Pentland, Lammermoor, and Moorfoot Hills, south of these rivers.

3. What do you know of the productions of Canada and the pursuits of the people?

Canada may be said to be a new country. Its vast extent is very largely covered with forests, chiefly of pine. The soil is extremely fertile, and the people are therefore engaged chiefly in pursuits which follow from these facts. Many are engaged in cutting down timber and preparing it for export, either in logs, or sawn, or as ash. Others are engaged in agriculture, wheat, barley, oats, maize, hemp, flax, and tobacco being largely grown. Besides pine the forests produce oak, maple, elm, birch, walnut, beach, and cedar. The mineral wealth of Canada is also very great, but the mines are not yet largely developed. Gold, iron, silver, copper, lead, and zinc are abundant. The fisheries of the eastern part of the Dominion are very important, employing large numbers of people, especially in Newfoundland.

History.

1. Name the different nations or tribes which conquered England at different times from its earliest-known history to the Norman conquest, with dates.

England was first conquered by the *Romans*, being invaded by Julius Cæsar in 55 and 54 B.C., and by Claudius in 43 A.D. The Roman occupation lasted till 410 A.D., and during the next forty years the *Picts and Scots* from Caledonia invaded the northern parts. These were driven back by the *Teutons* who were invited over by the British for that purpose. Various tribes of these, including *Saxons*, *Jutes*, *Angles*, and *Frisians*, came over at different times from 450 to 582 A.D. The country was again invaded by *Danes* from Norway, Sweden, and Denmark, at various times from 787 to 1014.

2. What led to the peace of Wedmore? Who were the parties engaged in the battle of Ethandune, and what were its results?

The battle of Ethandune was fought between the Danes under Guthrum and the English under Alfred. Alfred had visited the Danish camp, and gathering his forces had attacked them at the above place, and gave them such a beating that they were glad to yield to him. The Witan was then meeting at Wedmore, and a treaty was signed by which the Danes received East Anglia and part of Mercia, and Guthrum consented to receive Christian baptism.

3. Who was Dunstan? Give a short account of his life.

Dunstan was a monk who was made Abbot of Glastonbury by Edmund. In Edwy's reign differences arose respecting the secular clergy, who were often married, despite the prevalent opinion that the clergy ought not to marry. Dunstan took the part of the monks, and in consequence of his opposition to the king's marriage was driven out of the country. A revolt against Edwy, and the succession of Edgar led to Dunstan's return. He became Archbishop of Canterbury, and the chief counsellor to the king. Under his guidance the country was well governed. He died A.D. 989.

Composition.

Write from memory the substance of the following story:—

Two boys chanced to stray into the kitchen of a public-house. They found a large blazing fire and a box containing, according to the inscription, a Welsh dwarf; but there was not a person in the room besides. The boys eager to see the dwarf, but unable or unwilling to pay for the sight, began to consult how they should strive to obtain a view. They could not carry the box away, and the lock being on the inside they could not force it. At last they hit upon an ingenious stratagem. By joint efforts they pushed the box so near the fire that the dwarf, from the increased heat, was obliged to open the door and favour them *gratis* with his wished-for presence.

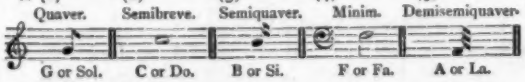
Music.

A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

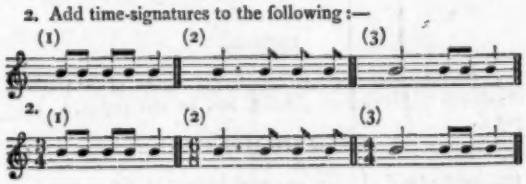
1. Write above each of the following notes its value-name (crotchet, &c.), and below each its pitch-name (A or La, &c.):—

1. (1) Quaver. (2) Semibreve. (3) Semiquaver. (4) Minim. (5) Demisemiquaver.



G or Sol. C or Do. B or Si. F or Fa. A or La.

2. Add time-signatures to the following:—



3. Write below each of the following intervals its name (major fourth, &c.):—

3.

Minor 2nd. Major or Perfect 5th. Octave or 8th.

TONIC SOL-FA NOTATION.

1. What are the measures commonly used? Write (*a*) a four-pulse tone, using two-pulse measure; and (*b*) a six-pulse tone, using three-pulse measure.

1. Two-pulse, three-pulse, four-pulse, six-pulse, and nine-pulse.

(*a*) |1 :— |— :— ‖ (*b*) |1 :— :— |— :— :— ‖

2. Write down the names of the following intervals:—(1) *te* to *doh*; (2) *soh* to *ray*^{1}; (3) *fah* to *fah*^{1}.

2. (1) Minor second; (2) major or perfect fifth; (3) octave or eighth.

3. Write the following an octave lower, and explain the meaning of "Key F":—

Key F.
|m :d :r |s :d^1 :l |s :— :— ‖

3. Key F.
|m$_1$:d$_1$:r$_1$ |s$_1$:d :l$_1$ |s$_1$:— :— ‖

"Key F" means that *doh* of the music is to be fixed to the particular sound of the scale called "F."

SECOND YEAR.

Pupil Teachers at end of Second Year.

FIRST PAPER.

Three hours and a half allowed.

Euclid.

MALES.

[All generally understood abbreviations for words may be used.]

1. To draw a straight line at right angles to a given straight line from a given point in the same.

What is the corollary that can be demonstrated by the aid of this proposition?

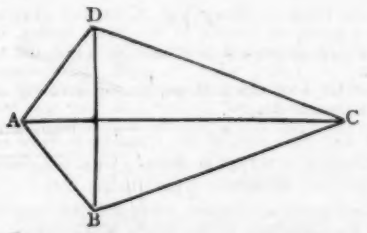
Euclid, Book I., Prop 11.

That two straight lines cannot have a common segment.

2. Any two sides of a triangle are together greater than the third side.

Euclid, Book I., Prop. 20.

3. The four sides of any quadrilateral are together greater than the two diagonals together.



Let ABCD be a quadrilateral, and AC and BD the two diagonals. The four sides AB, BC, CD, DA together are greater than BD and AC together.

The sides BA, AD are > BD in the △ BAD (I. 20), and the sides BC, CD are > BD in the △ BCD (I. 20).

Again: the sides AD, DC are > AC in the △ ADC (I. 20), and the sides AB, BC are > AC in the △ ABC (I. 20).

∴ twice AB, BC, CD, DA are together > than twice AC, BD; and AB, BC, CD, DA are together > than AC, BD.

Q. E .D.

Arithmetic.

FEMALES.

1. Add $\frac{3}{4}$ of £1, $\frac{2}{5}$ of £1 7s. 9d., and $1\frac{1}{2}$ of £10.

	£	s.	d.
$\frac{3}{4}$ of £1 $=\frac{3}{4}\times\frac{20}{1}=$	0	15	0
$\frac{2}{5}$ of £1 7s. 9d. $=\frac{2}{5}\times\frac{147}{1}=\frac{294}{5}$s. $=$	1	4	8
$1\frac{1}{2}$ of £10 $=\frac{3}{2}\times\frac{10}{1}=16=$	16	0	0
	17	19	8

Ans.

2. Express $2\frac{11}{27}$ and $7\frac{1}{9}$ as decimals.

$2\frac{11}{27}=2\frac{1}{111}=\underline{\cdot036}$. Ans.

$7\frac{1}{9}=7\cdot1$. Ans.

3. Reduce 18s. $1\frac{1}{2}$d. to the fraction of £1, and multiply the answer by $5\frac{1}{10}$.

s. d.
$\frac{18\ 1\frac{1}{2}}{£1}\times5\frac{1}{10}$
$=\frac{181}{200}\times\frac{101}{20}$
$=\frac{181}{200}\times\frac{101}{20}$
$=\frac{18281}{4000}$
$=4\frac{2281}{4000}$. Ans.

4. A father left £140 less than one half of his money to his eldest son, £20 and a quarter of his money to the second, £220 less than $\frac{1}{3}$ to his youngest son, and $\frac{1}{5}$ to his wife. Find what he left and the eldest son's share.

Total money left

£
$=\frac{1}{2}-140$ to eldest son
$\frac{1}{4}+20$ „ second „
$\frac{1}{3}-220$ „ youngest son
$\frac{1}{5}$ „ wife
$=\frac{17}{60}-340$
$\therefore\frac{17}{60}=340$
$\frac{1}{60}=20$
$\frac{60}{60}=\underline{£1200}$. Ans.

$\frac{1}{2}$ of £1200 − 140 $=\underline{£460}$. Ans.

Grammar.

MALES AND FEMALES.

1. Analyse the following passage, and parse fully the words in italics:—

To work when others are *idle will enable* you *to be* idle when *others* are at work.

(*a*) ANALYSIS.

Sentence.	Kind of Sentence.	Conn.	Subject.	Predicate.	Object.	Exten.
(*a*) To work will enable you to be idle	Principal Sentence.		To work	will enable	you (dir.) to be idle (indir.)	
(*b*) when others are idle	Adv. Sent. (time) to 'to work' in *a*.	when	others	are idle		
(*c*) when others are at work	Adv. Sent. (time) to 'to be idle' in *a*	when	others	are at work		

(*b*) *To*—particle, sign of inf. mood.

to work—reg. trans. verb, act., inf., used as abstract noun, neut., sing., 3rd, nom. to 'will enable.'

when—adverbial cop. conj. joining the sentences, '*If you* work' and 'others are idle.'

idle—adj. of quality, qualifying 'others.'

will—aux. verb to 'enable,' indicating future tense.

enable—reg. trans. verb, act., inf., pres., gov. by 'will.'

will enable—reg. trans. verb, act., ind., pres., 3rd, sing., agreeing with its nom. 'to work.'

to be—irreg. intrans. verb, act., inf., pres., gov. by 'will enable.'

others—indef. pers. pro., com., plur., nom. to 'are.'

2. Give the full force of the prefixes and the meaning of the following words:—

Controvert, efface, irresistible, invaluable, pollute, purpose, succumb.

Word.	Prefix.	Meaning.
Controvert	contro-	against; to turn against
Efface	ef-	out; to destroy the face, to rub out
Irresistible	ir-	not; not to be resisted
Invaluable	in-	not; not admitting of being valued
Pollute	pol-	towards; to wash towards, to defile
Purpose	pur-	forward; to place forth, to intend
Succumb	suc-	under; to lie down under

3. Paraphrase

Prepare you, generals:
The enemy comes on in gallant show;
Their bloody sign of battle is hung out
And something to be done immediately.

Generals! it is necessary that you should get ready for battle immediately. Our enemies are approaching us in all the glory of battle array; their ensigns declaring their intention to fight float in the breeze, and an attack will at once take place.

Geography.

1. Draw a map of India inserting the physical features and the chief towns.

2. Name the chief European seaports of the Mediterranean and the Baltic Seas, with their principal exports.

The chief ports of the Mediterranean are Barcelona, Marseilles, Genoa, Civita Vecchia, Leghorn, Naples, Palermo, Brindisi, Venice, Trieste, Syra, Nauplia, Hydra, Constantinople, Gallipoli, Saloniki; and the exports are silk, wool, dried and other fruits, raw cotton, olive oil, quicksilver, lead, glass, marble, straw hats, brimstone.

The chief ports of the Baltic are St. Petersburg, Riga, Dantzic, Konisberg, Stettin, Memel, Lubeck, Copenhagen, Christiania, Stockholm, Christiansand, and Gottenburg; and the exports are tallow, wheat, timber, hemp, potash, wool, corn, linen, flax, cattle, hides, provisions, tar, and iron.

3. What are the climatic advantages which New Zealand claims over Queensland and Canada as a settlement for people from this country.

A great part of Queensland is situated within the tropics. The heat, therefore, is intense, and to persons born and reared in this country the climate is, especially in the north, somewhat trying. Droughts also are frequent.

Canada, on the other hand, is very much colder than the British Isles; the winters are longer and much more severe, although the atmosphere is drier than that of this country.

The climate of New Zealand resembles that of this country, and a colonist settling there experiences little change, except that the winters are not so cold. Wind and rain are more prevalent, but the variations of temperature are less numerous. The amount of rainfall is greater, but the number of rainy days is less.

The chief climatic advantages of New Zealand are therefore those which are derived from the small amount of change from the climate of this country.

SECOND PAPER.

Two hours and a half allowed.

FEMALES.

(One hour allowed for the needlework specimens.)

Arithmetic.

MALES.

1. What percentage is a farthing of (*a*) a pound, (*b*) of a shilling, (*c*) of a penny, and 3 ozs. of a quarter?

$\frac{1}{4}$d. $= \frac{1}{960}$ of £1 or $\frac{100}{960}$ of £100 $=$ ·1041̇6 p. c.

$\frac{1}{4}$d. $= \frac{1}{48}$ of 1s. or $\frac{100}{48}$ of 100s. $=$ 2·08$\frac{1}{3}$ p. c.

$\frac{1}{4}$d. $= \frac{1}{4}$ of 1d. or $\frac{100}{4}$ of 100d. $=$ 25 p. c.

3 ozs. $= \frac{3}{112}$ of 1 qr. or $\frac{100}{112}$ of 100 qr. $=$ ·669.. p. c.

2. In what time will £120 amount to 120 guineas at 3½ per cent. per annum simple interest?

In one year £120 at 3½ will yield $\frac{120 \times 3\frac{1}{2}}{100} = £4$.

Total interest to make = 120 guineas − £120
= 120s. = £6.

∴ Time required = 4 : 6 :: 1 : x
= 1½ years. Ans.

3. A grocer, having bought 500 lbs. of rice, sells 8½ per cent. of the quantity to X, 140 lbs. to Y, and 2½ per cent. of the remainder to Z. What quantity has he left, and what is its value at 1s. 8d. a stone?

		lbs.
Amount sold to $X = \frac{8\frac{1}{2}}{100}$ of 500	=	42½
,, ,, Y	=	140
,, left = 500 − (42½ + 140)	=	317½
,, sold to $Z = \frac{2\frac{1}{2}}{100}$ of 317½	=	7·9375
,, left = 317·25 − 7·9375	=	309·3125. Ans.

Value $= \frac{309 \cdot 3125 \times 20}{14} =$ £1 16s. 9½d. Ans.

4. At what price must I sell out £5400 stock, which cost me 75½ per £100 stock, in order to gain 7½ per cent. on my outlay?

Cost price of stock = 75½ per £100 stock.
Required gain = 7½ p. c.
∴ gain on 75½ $= \frac{75\frac{1}{2} \times 7\frac{1}{2}}{100} = 5 \cdot 6625$.

Selling price per £100 stock = C. P. + gain
= 77½ + 5·6625
= 81·1625
= £81 3s. 3d. Ans.

History.

1. Relate briefly the historical events connected with the following places with dates:—Blackheath, Leicester Abbey, Norwich Castle, Smithfield, Fotheringay Castle.

In 1497, a rising in favour of Perkin Warbeck took place in Cornwall. A force of 16,000 marched to *Blackheath*, where they were attacked by Henry VII.'s forces, and 2000 of them slain.

Wolsey, after having incurred the displeasure of Henry VIII., retired to York, but was arrested in 1530 for high treason. On his way to trial he was taken ill, and died at *Leicester Abbey*.

During the reign of Edward VI., a rebellion in Norfolk, under Ket, a tanner, took place in 1550. It was put down by the Earl of Warwick, and Ket was hanged on the walls of *Norwich Castle*.

Smithfield is associated with the burning of Protestants chiefly in 1555, in the reign of Queen Mary. In Smithfield Wat Tyler was killed, 1381.

Fotheringay Castle is noted as the place of imprisonment and execution of Mary Queen of Scots, 1587.

2. What additions were made to the geographical knowledge of the people during the reign of Henry VII.?

During the reign of Henry VII., Columbus discovered the Bahamas, a group of islands in the West Indies, in 1492; Sebastian Cabot discovered Newfoundland, and the mainland of America, in 1497; while in 1486, Bartholomew Diaz doubled the Cape of Good Hope, thus discovering an ocean route to the East Indies.

3. What was the origin of the Crusades? How came the Kings of England to engage in them? Give the dates of the First and Second Crusades.

Peter, the Hermit of Amiens, witnessed the cruelties practised upon the Christians by the Turks in Palestine. On his return he complained to Pope Urban II., and under his sanction, a general crusade was preached throughout Europe, the First Crusade starting in 1095. Robert of Normandy, brother of William II., joined this Crusade, to vie with the other nobles of Christendom in the zeal for the recovery of the Holy Sepulchre. The Second Crusade took place in 1146. Richard I. joined the Third Crusade in his ardent zeal for the honours of chivalry. Edward I. joined the Fourth Crusade in imitation of Philip of France.

Teaching.

State the methods you employ in teaching children in Standard I. how to write neatly and correctly on slates.

Slates are ruled for text-hand and a large small-hand. I first find out what the children can do in the formation of letters. If they have been in the infant school, they can do these fairly well, but if in different schools, letters may be made in different ways. To secure uniformity, I give patterns on the blackboard. Next, examine quickly, and point out errors. Then, in the

combination of letters, I follow the same plan. After seeing that the forms of the letters are known, a lesson in transcription is given, and individual errors are pointed out. The position of the body, seat, and slate, and the holding of the pencil are carefully attended to. After lessons in transcription come easy lessons in dictation. Then they alternate.

Music.

A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

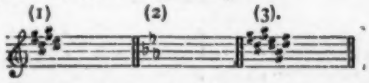
1. Write below each of the following intervals its name (major second, &c.) :—

1.

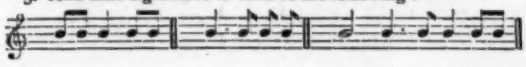
Perfect or Major 4th. Minor 3rd. Major or Perfect 5th.

2. Write the key-signature of each of the following major keys :—(1) of E ; (2) of A♭ ; (3) of F♯.

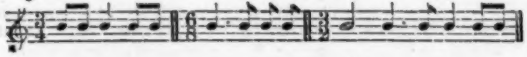
2. (1) (2) (3).



3. Add time-signatures to each of the following :—



3.



TONIC SOL-FA NOTATION.

1. What are the mental effects of (*a*) *soh* ; (*b*) *doh* ; (*c*) *me*?

1. (*a*) Grand and bright ; (*b*) firm and bold ; (*c*) calm and steady.

2. What are the names of the following intervals :—(1) *lah* to *ray*^{1} ; (2) *me* to *soh* ; (3) *fah* to *doh*^{1}?

2. (1) Major or perfect fourth ; (2) minor third ; (3) major or perfect fifth.

3. Write (1) a nine-pulse tone in a three-pulse measure ; and (2) an eight-pulse tone in a four-pulse measure.

3. (1) |1 :— :— |— :— :— |— :— :— ‖

(2) |1 :— |— :— |— :— |— :— ‖

THIRD YEAR.

Pupil Teachers at end of Third Year.

FIRST PAPER.

Three hours and a half allowed.

Euclid.

MALES.

[All generally understood abbreviations for *words* may be used.]

Answer two Questions, including No. 3, *if you can.*

1. The complements of the parallelograms, which are about the diagonal of any parallelogram, are equal to one another.

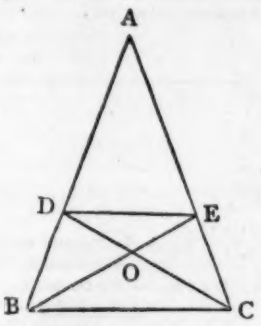
Euclid, Book I., Prop. 43.

2. To describe a square upon a given finite straight line.

Euclid, Book I., Prop. 48.

3. The angles ABC, ACB of an isosceles triangle are bisected by straight lines which meet AP, AC, at D and E respectively. Show that DE is parallel to BC.

Let the straight lines BE, CD bisect the ∠s ABC, ACB of the isosceles △ ABC, and meet AB, AC in D and E. Then DE is parallel to BC.



The ∠ ABC = ∠ ACB (Hyp.) and ∠ DBE = ∠ ECB, for they are halves of equal ∠s.

∴ ∠ OBC = ∠ OCB, and side OB = side OC (I. 6),

And the ∠ BOD = ∠ COE (I. 15),

∴ in △s DBO, ECO, the two ∠s DBO, BOD = two ∠s ECO, COE, and side BO = side CO.

∴ side OD = side OE (I. 26).

∴ ∠ ODE = ∠ OED (I. 6).

∴ ∠ DOE = ∠ BOE (I. 15), and the three interior ∠s of a △ are = two right ∠s.

∴ sum of ∠s = ODE, OED = sum of ∠s OBC, OCB.

∴ (Ax. 7) ∠ DEO = ∠ EBC. And they are alternate ∠s.

∴ (I. 29) DE is parallel to BC.

Q. E. D.

Algebra.

(*Answer two Questions, including No.* 3, *if you can.*)

1. Find the value of x in the following example :—

$$\tfrac{1}{7}(2x+7)-\tfrac{1}{7}\tfrac{1}{5}(2x-7)=1\tfrac{1}{8}-\tfrac{1}{10}(3x+4)$$

$$\tfrac{1}{7}(2x+7)-\tfrac{1}{7}\tfrac{1}{5}(2x-7)=\tfrac{1}{8}\tfrac{1}{0}-\tfrac{1}{8}\tfrac{1}{0}(3x+4)$$

$$20(2x+7)-36(2x-7)=990-27(3x+4)$$

$$40x+140-72x+252=990-81x-108$$

Collecting and transposing

$$49x=490$$

$$x=10$$

2. Resolve (*a*) $3(x^2-y^2)-5(x-y)^2$; (*b*) $a^3-b^3-3ab(a-b)$; and (*c*) $(x+y)^2+2(x^2+xy)-3(x^2-y^2)$ into elementary factors.

(*a*) $3(x^2-y^2)-5(x-y)^2$

$=3x^2-3y^2-5x^2+10xy-5y^2$

$=-2x^2-8y^2-10xy$

$=2(-x^2-4y^2-5xy)$

$=2(-x+4y)(x-y)$

(*b*) $a^3-b^3-3ab(a-b)$

$=a^3-b^3-3a^2b+3ab^2$

$=(a-b)^3$

(*c*) $(x+y)^2+2(x^2+xy)-3(x^2-y^2)$

$=x^2+2xy+y^2+2x^2+2xy-3x^2+3y^2$

$=4xy+4y^2$

$=4y(x+y)$.

3. Write down in words some of the common results in multiplication and division of algebraic examples.

In multiplication :—

The square of the sum of two quantities (a binomial) is equal to the sum of their squares plus twice their product.

The square of the difference of two quantities is equal to the sum of their squares minus twice their product.

The product of the sum and difference of two quantities is equal to the difference of their squares.

In division :—

If the index be odd x^n+y^n is divisible by $x+y$

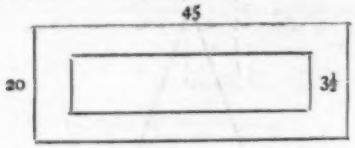
,, ,, x^n-y^n ,, ,, $x-y$

If the index be even x^n+y^n is divisible by neither $x+y$ nor $x-y$

,, ,, x^n-y^n is divisible by both.

Mensuration.

A road $3\frac{1}{2}$ yds. wide was made round a rectangular piece of ground, the sides of which were 45 and 20 yds. respectively, what did it cost at 1s. 9d. per sq. yd.?



Total area of ground
$= 45 \times 20 = 900$ sq. yds.
Area of ground inside the walk
$= (45-7)(20-7) = 494$ sq. yds.
$\therefore$ Area of walk $= 900 - 494 = 406$ sq. yds.
Cost of road $= 406 \times 1s.\ 9d.$
$= £35\ 10s.\ 6d.$ Ans.

Arithmetic.

FEMALES.

1. Reduce $3\frac{1}{2}$ in. to the decimal of a quarter of a mile, and £2 11s. $6\frac{3}{4}$d. to the decimal of £5.

$$\frac{3\frac{1}{2}\text{ in.}}{\frac{1}{4}\text{ mile}} = \frac{3\frac{1}{2}\text{ in.}}{440\text{ yds.}} = \frac{3\frac{1}{2}\text{ in.}}{15840} = \frac{7}{31680} = .0002206\dot{5}.$$ Ans.

4 | 3
12 | 6·75
20 | 11·5625
5 | 2·578125
·515625 Ans.

2. Find the values of $3{\cdot}5 + 2{\cdot}8\dot{3} + {\cdot}\dot{6} + 1{\cdot}175$; $11{\cdot}7\dot{3} - 10{\cdot}9\dot{1}\dot{6}$; $3{\cdot}375 \times 1{\cdot}\dot{6} \times 4{\cdot}8$; $\frac{3{\cdot}375}{4{\cdot}5}$.

3·5
2·8333
·6666
1·175
8·1746 Ans.

11·7333
10·9166
·816. Ans.

$3{\cdot}375 \times 1{\cdot}\dot{6} \times 4{\cdot}8$
$= 3\frac{3}{8} \times 1\frac{2}{3} \times 4\frac{4}{5}$
$= \frac{27}{8} \times \frac{5}{3} \times \frac{24}{5}$
$= 27$. Ans.

3·375
4·5
·675
·9
= ·75. Ans.

3. A bankrupt's debts amounted to £980, and his creditors received 13s. 6d. in the £; what was the value of his effects?

£ : £ :: s. d. : £ s.
1 : 980 :: 13 6 : 661 10. Ans.

4. A person sold ·15 of an estate to one person, and then $\frac{4}{17}$ of the remainder to another person. What part of the estate did he keep?

Total estate = 1
Amount sold = ·15
Amount left ·85
2nd Amt. sold = $\frac{4}{17}$ of ·85 = ·25
Amount he kept ·60 or $\frac{3}{5}$. Ans.

Grammar.

MALES AND FEMALES.

1. Analyse the following passage, and parse the words in italics:—

Hail, beauteous stranger of the grove!
Thou messenger of spring!
Now Heaven repairs thy rural seat,
And *woods* thy *welcome sing*.
What time the daisy decks the green,
Thy certain voice we hear;
Hast thou a star *to guide* thy path,
Or *mark* the rolling year? LOGAN.

ANALYSIS.

Sentence.	Kind of Sentence.	Connective.	Subject.	Predicate.	Object.	Extensn. of Pred.
Hail, beauteous stranger of the grove, thou messenger of spring			*Nom. of address*			
(*a*)						
Now Heaven repairs thy rural seat	Princ. Sent.		Heaven	repairs	thy rural seat	now (time
(*b*)						
And woods thy welcome sing	Princ. Sent. co-ord. with (*a*)	And	woods	sing	thy welcome	
(*c*)						
the daisy decks the green	Adj. Sent. to *time* in (*d*)		the daisy	decks	the green	
(*d*)						
thy certain voice we hear what time	Princ. Sent.		we	hear	thy certain voice	[on] what time (time)
(*e*)						
Hast thou a star to guide thy path	Princ. Sent.		thou	hast	a star [dir.] to guide thy path [ind.]	
(*f*)						
or mark the rolling year.	Princ. Sent.	or	[thou]	[hast]	[a star] to mark the rolling year [ind.]	

Thou—Per. pro., com., sing., 2nd, nom. of address, in app. with 'stranger.'
messenger—com. noun, com., sing., 2nd, nom. of address, in app. with 'stranger.'
woods—com. noun, neut., plur., 3rd, nom. to 'sing.'
welcome—abs. noun, neut., sing., 3rd, obj., gov. by 'sing.'
sing—irreg. trans. verb, act., ind., pres., plur., 3rd, agreeing with its nom. 'woods.'
what—rel. pro., used as adj., qualg. 'time.'
time—abs. noun, neut., sing., obj., gov. by 'at,' und.
hast—irreg. trans. verb, act., ind., pres., 2nd, sing., agreeing with its nom. 'thou.'
to guide—reg. trans. verb, act., inf., pres., gov. by 'hast.'
mark—reg. trans. verb., act., inf., pres., gov. by 'hast,' understood.

2. Paraphrase the above passage:—

I bid thee hail! thou lovely tenant of the woods and welcome harbinger of spring! Returning warmth has clothed in green thy country home, and trees and groves rejoice at thy approach. When the flowers first deck the fields we are sure to hear thy voice. How findest thou thy way across the sea? Is there some star to tell thee of the changing year, or guide thee safely back?

3. Name some of the affixes in geographical names which are not of English origin, with examples of their use.

Ark—an altar, as Grimsargh.
beck—a brook, as Wansbeck, Troutbeck.
by—a town, as Whitby, Grimsby.
dal—a dale or valley, as Teesdale.
ey—an island, as Orkney, Sheppey.
fell—a hill, as Scafell, Snaefell.
ford—an arm of the sea, as Milford.
garth—a field, an enclosure, as Applegarth.
gate—a way or passage, as Westgate.
holm—an island, as Bornholm.
kirk—church, as Ormskirk.
force—a waterfall, as High Force.

4. Give examples of Keltic words introduced into English in modern times.

Shamrock, reel, strathspey, brogue, clan, claymore, plaid, pibroch, whiskey

Geography.

MALES.

(*Answer Two Questions.*)

1. Draw a map of Egypt and the Soudan.

2. Describe the mountain system of Asia.

The great watershed of Asia stretches rom N.E. to S.W., through the whole continent. The northern slope is the great plain of Siberia; the southern slope is diversified by extensive plateaus and lofty mountain range , intersected by deep valleys. The principal ranges stretch in a westerly, south-easterly, and north-easterly direction from the Bolor Tagh Mts., which reach 19,000 feet in height. The principal ranges to the west are Hindoo-koosh, Paropamisna, Elburz, Mts. of Armenia, Taurus, Anti-Taurus, and Lebanon. To the south-east there are the Himalayas, the loftiest mts. in the world, Mt. Everest being 29,000 feet high; the Karakorum Mts in Thibet, the Mts. of Aracan and Cambodia, and the lesser ranges, Vindhya, Ghauts, Neilgherries in Hindustan. Stretching to the N.E. there are the Kuen-Lun, the Pe-ling, Thian Shan, Altai, and Yablonoi Mts., and the Aldan Mts. in the extreme east of Siberia.

In these ranges there are many lofty peaks, and the mountain system of Asia raises the average height of surface of the continent of Asia much above that of the other continents. The mountains are the sources of many large rivers.

3. What accounts for the dryness of the climate and the general sterility of a great part of Africa?

The greater part of Africa is situated within the tropics. It has few mountains, and those which it has are situated near the coast. Its coast is very little indented. As the land receives so much heat, and there are no mountains whose cold summits would condense the vapours carried over the country from the oceans, the air instead of being chilled is heated as it passes over the country, and its capacity for holding moisture is increased. There is, therefore, little rain, and the climate is dry. The absence of moisture and the nature of the surface, which is made up in great part, especially in the north, of sand and salt, accounts for the sterility of the soil.

SECOND PAPER.

Two hours and a half allowed.

Needlework.

FEMALES.

(*One hour is allowed for the Exercises in Needlework.*)

Arithmetic.

MALES.

1. The retail price of a book is 5s. If the expenses of sale were 15 per cent. and the profits 25 per cent. on the cost price, what was the original cost of the book?

C. P. + exp. + gain = Retail price.
100 + 15 + 25 = 5s.
140 = 5s.
1 = $\frac{5}{140}$s.
100 = $\frac{5 \times 100}{140}$
= 3s. 6$\frac{3}{7}$d. Ans.

2. The sides of a triangular field which contain a right angle are 750 and 625 links respectively, what is the length in chains of the third side?

$(750^2 + 625^2) = (562500 + 390625) = 953125$
$\sqrt{953125} = 976{\cdot}27 +$ links
$= 9{\cdot}7627 +$ chains. Ans.

3. A man left ·375 of his estate to one son and the remainder to another. The difference in the value of their legacies was £250. Find the value of the estate.

1 − ·375 = ·625
The diff. in value between ·625 and ·375 is £250
∴ ·25 of estate = £250
And the whole estate = £1000. Ans.

4. Eggs which cost 7½d. per doz. were sold at 16 for a shilling, what was the gain or loss per cent.?

16 for 1s.
1 ,, $\frac{1}{16}$ = $\frac{1}{4}$d.
12 ,, $\frac{3}{4} \times 12$ = 9d. S.P.
∴ Gain on 7½d. = 9d. − 7½d. = 1½d.
And gain per cent. = 7½ : 100 :: 1½ : 20. Ans.

History.

MALES AND FEMALES.

1. What led to the Act of Settlement? What were its provisions, and when did it become law?

William III. and Mary II. were without issue, and on the death of the Duke of Gloucester, the last surviving child of the Princess Anne (afterwards Queen), it became necessary to provide for a Protestant successor to the throne, and so exclude the Pretender and his descendants. It provided that the crown, in default of issue of William and Anne, should pass to Sophia of Hanover and her descendants; that the successor to the throne should be in communion with the Church of England; that England should not engage in war on behalf of the foreign possessions of its king without the consent of Parliament; that the Sovereign should not leave Great Britain or Ireland without the consent of Parliament; that the judges should retain office during good behaviour; and that no person in the service of the Crown should sit in the House of Commons. The Act was passed in 1701.

2. What attempts were made by James II. and his descendants to regain possession of the throne?

After the second flight of James to France, he was invited by Tyrconnel, Lord-lieutenant of Ireland, to that country. Assisted by Louis of France, James went to Ireland in 1689. In Dublin he called a Parliament, and at the head of troops besieged Londonderry for a time. After the relief of Londonderry, the battles of Newton Butler and the Boyne were fought. James was defeated, and fled to France.

In 1715, the son of James, styled the 'Pretender,' attempted to overthrow the Government of George by a rebellion in Scotland. The Earl of Mar first raised the standard of rebellion. The insurgents marched as far south as Preston, where they were compelled to surrender. Another engagement took place at Sheriffmuir, which was undecided, but after which the Highlanders gradually dispersed.

In 1745, the Young Pretender, grandson of James II., also attempted to regain the throne. The rebels gained the battle of Preston Pans, and advanced into England as far as Derby. They were followed to Scotland by the Duke of Cumberland, and defeated at Culloden, after which Charles escaped to the Continent.

3. What were some of the benefits derived by England and Scotland respectively from the Union of the Parliaments of those countries?

England lost a troublesome neighbour, and one which had sometimes been a powerful enemy as the ally of France, and gained a firm friend and useful ally.

Scotland was no longer in danger of ultimate conquest or of ruinous wars as the result of collision with her southern neighbour; her trade and commerce were rapidly developed, and she rapidly increased in wealth and prosperity.

Teaching.

Write the notes of a lesson for an upper class on

'THE INFINITIVE MOOD.'

Recapitulate previous lessons on the indicative, and imperative, and subjunctive moods, and show that these are limited by reference to agent or agents, that is, that they have person and number.

Then write sentences on blackboard containing examples of infinitive mood, as 'I love to read,' 'To err is human,' 'I delight to go.'

From these examples show that the verb is used without reference to agents, and so get

(*a*) *Definition.*—The infinitive mood (exp. root, Lat. infinitus, in, finitus, unbounded) is that form of the verb which denotes an action unlimited as regards person and number.

(*b*) *How known.*—Generally by sign 'to.' Show how in O.E. the inf. was a noun and had cases; one, the dative, having 'to' before it, and also different endings. When these were lost, 'to' was used before all the cases.

(*c*) *How used.*—

(1) Along with auxiliaries: as, 'I can go,' 'He should go,' 'I must go.' Show how the sign 'to' is needed if the *meaning* of the auxiliary be substituted, as, 'I can go'='I have the power *to* go.' 'He should go'='He ought *to* go,' etc.

(2) As a noun:
e.g., To return was unwise.
He longed to remain.
I love to read.

(3) To express purpose:
As, He stood up to read.
They went away to catch fish.

(4) To qualify nouns or adjectives:
As, We have a house to dwell in.
He is ready to forgive.

(5) After verbs *make, dare, bid, feel, hear, see,* and *let* without the sign *to*.

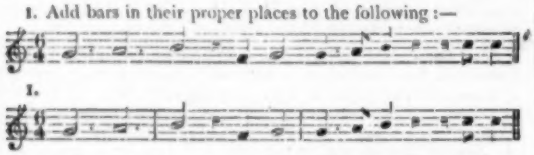
(*d*) Give examples orally and on slate or paper, and have uses pointed out.

Music.

A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

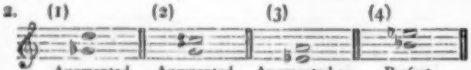
1. Add bars in their proper places to the following:—



1.

2. Write below each of the following intervals its name (minor third, &c.):—

2. (1) (2) (3) (4)



Augmented 5th. Augmented 4th. Augmented or Piuperfect 4th. Perfect 4th.

3. What are the meanings of the following terms:—(*a*) *Largo*; (*b*) *Vivace*; (*c*) *Presto*.

3. (*a*) Very slow; (*b*) very lively; (*c*) very quick.

TONIC SOL-FA NOTATION.

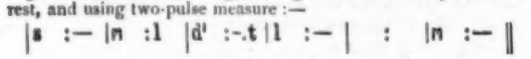
1. Write perfect or major fifths above:—(1) *ray*; (2) *fah*; (3) *lah*.

1. (1) *lah*; (2) *doh*^{1}; (3) *me*.

2. What is the meaning of the following terms:—(*a*) *Largo*; (*b*) *Vivace*; (*c*) *Presto*.

2. (*a*) Very slow; (*b*) very lively; (*c*) very quick.

3. Re-write the following, halving the value of every note and rest, and using two-pulse measure:—



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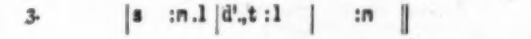


FOURTH YEAR.

Pupil Teachers at end of Fourth Year.

FIRST PAPER.

Three hours and a half allowed.

Euclid.

MALES.

[All generally understood abbreviations for *words* may be used.]

(*Answer two Questions, including No. 3, if you can.*)

1. If a straight line be divided into any two parts, the sqs. on the whole line, and on one of the parts, are equal to twice the rectangle contained by the whole and that part, together with the sq. on the other part.

Euclid, Book II., Prop. 7.

2. To describe a square that shall be equal to a given rectilineal figure.

Euclid, Book II., Prop. 14.

3. Prove the proposition of Euclid given in Question 1 algebraically.

A C B

Let AB be the given straight line, and let it be divided into any two parts at the point C; the sqs. on AB, BC shall be =twice the rect. AB.BC, together with the sq. on AC.

For let AB contain x linear units, and AC y, and CB z units

Then $x=(y+z)$

and squaring both sides

$$x^2=y^2+2yz+z^2$$

Adding z^2 to each side,

$$\therefore\ x^2+z^2=y^2+2yz+2z^2.$$

But $2yz+2z^2=2(y+z)z$

$$=2xz$$

$$\therefore\ x^2+z^2=y^2+2xz.$$

That is, sq. on AB+sq. on BC

=sq. on AC+twice AB.BC.

Q. E. D

Algebra.

(*Answer two Questions.*

1. Solve (1) $x(y+7)=y(x+1)$

$$2x+20=3y+1.$$

(2) $ax+by=c^2$

$$\frac{a}{b+y}-\frac{b}{a+x}=0.$$

(1) $x(y+7)=y(x+1)$

$$2x+20=3y+1$$

$$xy+7x=xy+y$$

$$2x+20=3y+1$$

Collecting and transposing

$$7x-y=0$$

$$2x-3y=-19$$

$$21x-3y=0 \quad \text{(I.)}$$

$$2x-3y=-19 \quad \text{(II.)}$$

$$19x = 19$$

$$x=1$$

Substituting value of x in (1)

$$21-3y=0$$

$$21=3y$$

$$y=7.$$

$\underline{1, 7.}$ Ans.

(2) $ax+by=c^2$

$$\frac{a}{b+y}-\frac{b}{a+x}=0$$

$$ax+by=c^2$$

$$a^2+ax-b^2-by=0$$

$$ax+by=c^2 \quad \text{(I.)}$$

$$ax-by=b^2-a^2 \quad \text{(II.)}$$

$$2ax = -a^2+b^2+c^2$$

$$x=\frac{-a^2+b^2+c^2}{2a}$$ Ans.

Subtracting (II.) from (I.)

$$2by=c^2-a^2-b^2$$

$$y=\frac{c^2+a^2-b^2}{2b}$$ Ans.

2. Simplify:—

$$\frac{x-\frac{x-y}{1+xy}}{1+\frac{x(x-y)}{1+xy}}$$

$$\frac{x-\frac{x-y}{1+xy}}{1+\frac{x(x-y)}{1+xy}}$$

$$=\frac{x^2y+y}{1+xy}\times\frac{1+xy}{x^2+1}$$

$$=\frac{x^2y+y}{x^2+1}$$

$$=\underline{y.}$$ Ans.

3. What is a *Quadratic equation?* Name the different kinds, and state the difference between them.

$$\text{Solve } \frac{5x}{x+4} - \frac{3x-2}{2x-3} = 2.$$

A Quadratic Equation is one in which the square of the unknown quantity is found.

There are two kinds—*pure and adfected.*

A *pure* quadratic is one in which the square only is found, without the first power, as, $x^2+20=0$.

An *adfected* quadratic contains the first power, as well as the square, as, $x^2+2x+5=30$.

$$\frac{5x}{x+4} - \frac{3x-2}{2x-3} = 2$$

$10x^2-15x-3x^2-10x+8=4x^2+10x-24$

$3x^2-35x=-32$

$36x^2-420x+(35)^2=-384+1225$

$6x-35=\pm 29$

$6x=6$ or 64

$x=$ 1 or $10\frac{2}{3}$. Ans.

Mensuration.

A wheel turns round 4,400 times in a distance of 10 miles; what is its diameter?

10 miles = 17600 yds.

Circumference of wheel $=\frac{17600}{4400}=4$ yds. $=12$ ft.

3·14159 : 1 :: 12 ft. : 3·8197+ft. Ans.

Arithmetic.

FEMALES.

1. In a dictation lesson given to 35 scholars, 14 had no mistakes, 8 had 1, 6 had 2, 4 had 3, 2 had 5, and 1 had 7; find the average number of mistakes.

$14\times 0=$	0 mistakes.
$8\times 1=$	8 ,,
$6\times 2=$	12 ,,
$4\times 3=$	12 ,,
$2\times 5=$	10 ,,
$1\times 7=$	7 ,,
35	=49 mistakes.
	$1=1\frac{4}{7}$,, Ans.

2. Two men start in opposite directions to walk round a park, one at the rate of $3\frac{1}{2}$ miles an hour, the other at $4\frac{1}{2}$ miles an hour; they meet in 45 minutes. What is the distance round the park?

45 mins. $=\frac{3}{4}$ hr.

Distance walked by one $=\frac{3}{4}\times 3\frac{1}{2}=2\frac{5}{8}$ miles.

,, ,, other $=\frac{3}{4}\times 4\frac{1}{2}=3\frac{3}{8}$,,

,, round the park $=2\frac{5}{8}+3\frac{3}{8}$

$=5\frac{1}{1}\frac{1}{2}$ miles. Ans.

3. If 20 men can do a piece of work in 14 weeks, working 6 days a week and 8 hours per day, in how many weeks will 18 men do it, working 5 days a week and 9 hours a day?

Men	18	: 20 : :	14 weeks : $16\frac{1}{3}\frac{1}{3}$ weeks.
Days	5	: 6	
Hours	9	: 8	

$=16\frac{1}{3}\frac{1}{3}$ weeks. Ans.

4. I bought £2,500 Mexican Railway Stock at $70\frac{1}{4}$; on the stock rising to $78\frac{1}{4}$ I sold out. What was my gain, brokerage being paid in each case, and what would my yearly income be from the proceeds invested in the $3\frac{1}{2}$ per cents. at par?

Gain = (S. P. − C. P.) × No. of cents. of stock

$=(78\frac{1}{4}-\frac{1}{4})-(70\frac{1}{4}+\frac{1}{4})\times 25$

$=(78\frac{1}{2}-70\frac{1}{2})\times 25$

$=$ £206$\frac{1}{4}$ gain. Ans.

Proceeds of sale $=78\frac{1}{2}\times 25$

$=1959\frac{1}{2}$

Annual income $=\frac{1959\frac{1}{2}\times 3\frac{1}{2}}{100}$

$=$ £68 11s. 6$\frac{3}{4}$d. Ans.

Grammar.

MALES AND FEMALES.

1. Analyse the following, parsing the words in italics:—

None remember thee now thou'rt gone!
Or they could not choose *but weep*,
When they thought of thee, my gentle *one*,
In thy long and lonely sleep.
Fain would I murmur thy name, and tell
How fondly *together* we used *to dwell*—
But none remember thee
Save me. BARRY CORNWALL.

ANALYSIS.

Sentence.	Kind of Sentence.	Con. nective.	Subject.	Predicate.	Object.	Extension.
(*a*) None remember thee now	Princ. sent.		None	remember	thee	now (time)
(*b*) thou art gone,	Adv. of time to *a*.	[that]	thou	art gone		
(*c*) Or they could not choose but weep	Princ. disj. co-ord. to *a*.	or	they	could not (neg.) choose	but [= except] weep (ind.)	
(*d*) When they thought of thee in thy long and lonely sleep.	Adv. (*time*) to *c*	when	they	thought	of thee, my gentle one, in thy long and lonely sleep [ind.]	
(*e*) Fain would I murmur thy name,	Princ. sent.		I	would murmur	thy name	fain (manner)
(*f*) and tell	Princ. sent. co-ord. with *e*	and	[I]	[would] tell		
(*g*) how fondly together we used to dwell.	Noun sent. obj. to *f*.		we	used	to dwell together, how fondly [ind.]	
(*h*) But none remember thee save me.	Princ. sent. disj. co-ord. with *e* and *f*.	but	none save me	remember	thee	

None—numl. adj., qualg. 'persons' und.

or—disj. conj., joining the sents., 'None remember' and 'They could not choose.'

but—=*except*; prep., showing reln. between *anything* und. and *weep*.

Construction.—Choose *anything* except weeping or to weep.

(It might also be parsed as conj., or as an adverb if the constr. were *not but*=*only*.)

weep—irreg. intrans. verb, act., inf., pres., used as abs. noun =weeping, obj., gov. by *but*.

one—adj. used as noun, fem., sing., 2nd, nom. of address, or in app. with 'thee.'

fain—adv. of manner, qualifying *would murmur*.

how—adv. of deg., qualifying *fondly*.

together—adv. of manner, qualifying *to dwell*.

to dwell—irreg. intrans. verb, act., inf., pres., gov. by *used*.

save—prep., showing rel. between *none* and *one*.

2. To what language is English most closely related? Of what elements is it now composed?

English is a low German language, and is most closely related to Dutch, Frisian, and Flemish.

It is mainly composed of Saxon words, but it has in it a large mixture of Latin and French words, besides a few Greek, Celtic, Danish, Italian, Spanish, Portuguese, Arabic, Hindoo, Persian, Turkish, Hebrew, American, Russian, and other words.

3. Name some old English writers, and their works.

Cædmon - - - - -	*A practical paraphrase of Scripture History.*
Bœda (The Venerable Bede) -	*Ecclesiastical History.*
King Alfred - - - -	*Translations of Bede*:—part of the *Anglo-Saxon Chronicle.*
Layamon - - - -	*Brut.*

4. Into what periods may English literature be divided?

Old English -	450 A.D. to 1100 A.D.
Early English -	1100 ,, ,, 1250 ,,
Middle English	1250 ,, ,, 1485 ,,
Modern English	1485 ,, ,, 1885 ,,

Geography.

Answer two questions.

1. Draw a map of the Pacific Ocean.

2. Compare the river-systems of North America and Asia.

The mountains of America lie near the west coast, and there are thus no rivers of importance which flow in a westerly direction. A vast extent of territory lies east of the Rocky Mountains, unbroken by any elevations of magnitude. The rivers of America may thus be said to flow through an immense plain in a south-easterly direction, the largest being 4,000 miles in length.

In Asia, the highland is chiefly in the centre, and the most gentle slope is towards the Arctic Ocean. The southern slope is abrupt, and great masses of mountains occupy a great part of the remainder of the Continent. The rivers, therefore, are found in valleys, sometimes broad and extensive, but not so extensive as the prairies of America. Their courses are not so long, nor are they so well-suited for commerce as the rivers of America. Rivers in Asia drain every part of the great central table-land, and flow in all directions—north, south, east, and west.

3. Explain, as to a class, the phases of the moon.

The moon is a dark body, and can only reflect the light which is thrown on it. The sun can only shine on one-half the moon at once, and it depends entirely upon the positions of the sun, moon, and earth, with regard to each other, as to how much of that enlightened half we see on the earth.

If the sun and moon are on opposite sides of the earth, and the earth does not come between them, then the whole lighted surface of the moon is seen.

On the other hand, if they are both on the same side of the earth, then none of the lighted surface of the moon would be seen. These different appearances are called 'phases'; when the moon is seen at full it is called *full moon*, and when no moon at all is seen, then is the time of new moon. Between these two phases all the other phases come, gradually increasing or decreasing as the moon changes its position from the same to the opposite side of the earth from that occupied by the sun, or the reverse.

To make this explanation still more clear, use before the class the blackboard, the diagrams, and, if possible, the tellurium. If not available, a common globe held in the hand, with the sun or a lamp shining on it, can be made to serve the purpose.

SECOND PAPER.

Two hours and a half allowed.

Needlework.

FEMALES.

One hour allowed for working the needlework specimens.

Arithmetic.

MALES.

1. Which stock is best to invest in—the 3½ per cents. at 93, or the 3 per cents. at 81?

The ratio of receipts in each stock is as

$$3\tfrac{1}{2} : \tfrac{3}{81}$$
$$93$$
$$\tfrac{1}{186} : \tfrac{1}{507}$$
$$507 : 558$$

The 3½ per cents. are therefore the best investment.

2. Find the true discount on a bill for £275 6s. 8d. for 15 mos. at 4 per cent. per annum.

Int. on £100 for 15 mos. at 4 p.c. = $\frac{5}{4}$ of 4 = £5.

∴ Discount on £275 6s. 8d. =

£ £ £ s. d. £ s. d.

105 : 5 :: 275 6 8 : 13 2 2½. Ans.

3. The distance from Newcastle to Carlisle is 60 miles, 15 miles being uphill, 20 downhill, and the rest level. If a bicyclist goes at the rate of 12 miles an hour on level ground, 15 miles downhill, and 15 miles uphill, what will be the difference in time between going to Carlisle and returning?

Time in going = $\frac{15}{5}$ = 3 hours uphill
$\frac{25}{12}$ = 2$\frac{1}{12}$,, on level
$\frac{20}{15}$ = 1$\frac{1}{3}$,, downhill
= 6$\frac{5}{12}$ hrs.

Time in returning = $\frac{15}{12}$ = 2$\frac{1}{12}$ hours on level
$\frac{20}{5}$ = 4 ,, uphill
$\frac{15}{15}$ = 1 hour downhill
= 7$\frac{1}{12}$

Diff. = 7$\frac{1}{12}$ − 6$\frac{5}{12}$ = $\frac{1}{2}$ hr. or 40 min

4. Three workmen work together for half an hour at reaping. A could do the whole in 12 hours, B in 4, and C in 3 hours. C then left off. How long would A and B take to finish it?

Work done in 1 hr. = $\frac{1}{12} + \frac{1}{4} + \frac{1}{3} = \frac{8}{12}$
$\frac{1}{2}$,, = $\frac{4}{12}$ or $\frac{1}{3}$
Work still to do = 1 − $\frac{1}{3}$ = $\frac{2}{3}$

A can do in 1 hr. $\frac{1}{12}$
B ,, ,, $\frac{1}{4}$
A + B ,, ,, $\frac{1}{12} + \frac{1}{4} = \frac{1}{3}$
Time for A and B to do $\frac{1}{3}$ = 1 hr.
,, ,, $\frac{2}{3}$ = 2 hrs. Ans.

History.

MALES AND FEMALES.

1. What events are connected with the following dates?—1745, 1759, 1760, 1801, 1832, 1846, 1851, 1854, 1867.

1745—Rebellion in Scotland; attempt of the Young Pretender to gain the throne.
1759—Conquest of Canada.
1760—Death of George II., and accession of George III.
1801—The Union of the English and Irish Parliaments.
1832—The passing of the First Reform Bill.
1846—The repeal of the Corn Laws—Famine in Ireland.
1851—The Great Exhibition.
1854—The Crimean War.
1867—The passing of the Second Reform Bill.

2. Explain briefly the Constitution of England.

The Government of England is a limited monarchy, and the three estates of the realm are the Sovereign, Lords, and Commons. The Sovereign acts upon the advice of a limited number of the members of the Privy Council, called the Cabinet Ministers. The sovereign alone has the power of making war or peace, or treaties, of exercising the prerogative of mercy in case of condemned criminals, and of conferring titles of nobility. The House of Lords is mostly hereditary. The House of Commons is elective, and consists of 658 members, from counties and boroughs of the United Kingdom. The House of Commons alone has the power of initiating money bills, but others may be introduced in either House. Before any proposition can become law, it must receive the sanction of the three estates of the realm.

3. What was the cause of the loss of the American Colonies in the reign of George III.?

In 1765 the Stamp Act was extended to the American Colonies, but the colonists objected to the imposition as being contrary to the spirit of the English constitution. In 1766 the Stamp Act was repealed, but duties were charged upon tea, glass, paper, etc., exported to the American colonies. Eventually all these were removed except the tax on tea. Riots took place, and at Boston, several shiploads of taxed tea were emptied into the harbour in 1773. Although strongly urged to yield by Chatham, Burke, and Fox, the Government refused, and a Declaration of Independence was made by the Colonists in 1774. Then followed a long and disastrous war. Battles were fought

at Lexington, Bunker's Hill, Long Island, Brandywine, and Campden. The English under General Burgoyne surrendered in 1777, and again at York Town 1781. England acknowledged the independence of the Americans in 1782.

Teaching.

Write out notes of a lesson on 'Earthquakes.'

Call attention to recent occurrences in Ischia and Spain, and derive the meaning of the term 'earthquake.'

(*a*) *Causes of Earthquakes.*—Refer to volcanoes, and show that there is great heat in the earth, that water percolates through to this heat, and that steam and gases in the endeavour to escape cause the quaking. Illustration—Tea-kettle lid.

(*b*) *Kinds of Earthquakes.*—

(1) *Tremulous.*—The earth shakes to and fro; the least destructive; common in S. America near the Equator.

(2) *Vertical.*—Destructive, upheaval or subsidence, as island near Java.

(3) *Horizontal.* (4.) *Rotatory*, very uncommon.

(*c*) *Locality of Earthquakes.*—Generally in neighbourhood of volcanoes. Where there is no volcano to serve as a vent, the earthquake is most destructive.

In Europe: in the Mediterranean.
In Asia: in the central districts.
In S. America.
In Iceland.

(*d*) *Effects of Earthquakes.*
Great damage to life and property.
Upheavals of land.
Violent wave-motions.

(*e*) *Memorable Earthquakes.*
Callao destroyed in 1746.
Lisbon in 1755. 60,000 persons lost their lives.
Cumana in 1797. 40,000 perished.
Caraccas in 1812. 12,000 killed.
Valparaiso in 1822. Coast of America permanently raised.
S. America in 1868.
Ischia in 1883.
Spain, Malaga, in 1885.

Music.

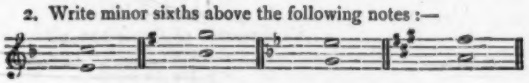
A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

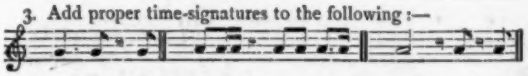
1. Write in the Treble clef the ascending and descending scales of F minor, using sharp sixth and seventh ascending, but not descending, and placing the necessary flats, &c., before the notes:—

1.

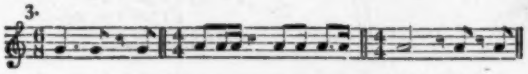
2. Write minor sixths above the following notes:—



3. Add proper time-signatures to the following:—



3.



TONIC SOL-FA NOTATION.

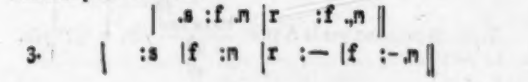
1. Write an ascending and descending minor scale, using the sharp sixth and seventh in ascending but not descending.

1. l, t, d r m ba se l s f m r d t, l,

2. Write minor sixths above the following notes:- (1) *ray*; (2) *te*; (3) *fah*.

2. (1) *ta*; (2) *soh*; (3) *ra*.

3. Re-write the following, doubling the value of each note. Use four-pulse measure:—



3.

Publications Received.

Boulton (Joseph) and Co.—

Tots and Cross Tots. By Rev. J. Robertson, LL.D.
Virgil's Æneid. Book I. By Rev. J. Robertson, LL.D.
Elementary Practical Chemistry. By J. Spencer, B.Sc.

Blackie and Son—

Shakspeare's King John. With Notes.
Readings from 'Robinson Crusoe.'

Chambers (W. and R.)—

Short Narratives.
Select Poetry for Recitation. Standards I. to VII.
Guide-Book for Pupil Teachers. By J. Beveridge.
Shakespeare's King Henry V. With Notes.
Shakespeare's King John. With Notes.
Senior English History. For Standards V. and VI.

Crosby Lockwood and Co.—

Outlines of Roman History. By the Rev. B. G. Johns.

Educational Supply Association, The—

Social Economy for Children. By E. E. Ellis.

Hachette et Cie.—

An Introduction to French Conversation. By A. Charlin.

Hodder and Stoughton—

Teaching and Teachers. By H. Clay Trumbull, D.D.

Hodgson (F.)—

Over-work. By Mrs. S. Bryant, D.Sc.

Johnston (A.)—

Johnston's Standard Copy Books. Nos. 9 to 16.

Leng (J.) and Co.—

On Educating the Mental Faculties. By E. Munroe.

Letts, Son, and Co.—

The Illustrated Household Magazine. January.

Longmans and Co.—

Longman's Magazine. January.
The Quarterly Arithmetical Tests. Standards II. to VII. (Longman's Modern Series.)
The Practical Algebraical Test Cards. Stages 1, 2, and 3. By D. Bain, B.A.
Virgil's Æneid. Book VII. (White's Grammar School Texts.)
Manual of English Literature. By T. Arnold, M.A.
The Public Schools' Historical Atlas. By C. Bolbeck, M.A.
Key to Hydrostatics and Pneumatics. By P. Magnus, B.Sc., B.A.

Macmillan and Co.—

Differential Calculus. By A. Knox, B.A.

Murby (T.)—

Electrical Units. By Dr. R. Wormell, M.A.
Notabilia of Geography. By W. Blanchard, A.C.P.

Nelson (T.) and Sons—

The Royal Drawing Books. Nos. 6 to 12.

Philip (G.) and Son—

Philips' Geographical Readers. Nos. 1 to 6.

Relfe Brothers—

The Woodford French Book. By G. F. Sykes, B.A.
Odds and Ends of Useful Knowledge. By a Lady.
Practical French Grammar. By H. Bourdache.
Hints and Rules to Correct Some Common Mistakes in Classical Composition. By F. A. Hooper, M.A.

Smith, Elder, and Co.—

The Cornhill Magazine. January.

Query Column.

RULES.

1. Each correspondent is restricted to *one question.* We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher*, *Pilgrim Street, Ludgate Hill, London, E.C.*

Arithmetic.

1. CLIPPER.—Find at what time between 3 and 4 o'clock the minute-hand of a clock is 30 minutes before the hour-hand.

The minute-hand moves 12 times as fast as the hour-hand;
∴ The difference between the rates of the minute and hour-hands is 11 times the rate of the hour-hand;
The minute-hand must gain 45 min. on the hour-hand to be 30 minutes before it;

∴ Distance gone by hour-hand = 45 min. ÷ 11
= $4\frac{1}{11}$ min.;

∴ Time = 45 min. + $4\frac{1}{11}$ min. past 3
= $49\frac{1}{11}$ min. past 3.

2. PUZZLED.—(*a*) What income is derived from £1350 invested in the 6 per cents. at $111\frac{1}{2}$?

(*b*) What change in his income will the possessor of it make, if he sell out, and invest the proceeds in the $4\frac{1}{2}$ per cents. at $79\frac{1}{2}$, brokerage being charged in both transactions? (*Dalton.*)

(*a*) Income in 1st case = 6 p. c. on £1350
= £81. Ans.

(*b*) Stock in 2nd case = £1350 × $\frac{111}{6}$
= £$1498\frac{8}{8}$;
Income ,, ,, = $4\frac{1}{2}$ p. c. on £$1498\frac{8}{8}$
= £$\left(\frac{1498\frac{8}{8}}{8} \times \frac{9}{200}\right)$
= £$\frac{2997}{40}$
= £84 5s. $9\frac{3}{5}$d.;

∴ Difference in incomes = (£84 5s. $9\frac{3}{5}$d. − £81) gain.
= £3 5s. $9\frac{3}{5}$d. gain. Ans.

3. ALIE SLOPER.—If silver be worth 5s. 6d. an oz. and pure gold be worth £4 5s. an oz., what would be the weight of a 15s.-piece, containing 92·5 per cent. pure gold and the rest silver?

(£4 5s. × $92\frac{1}{2}$) + (5s. 6d. × $7\frac{1}{2}$)
= (85s. × $92\frac{1}{2}$) + (5$\frac{1}{2}$s. × $7\frac{1}{2}$)
= 7862$\frac{1}{2}$s. + 41$\frac{1}{4}$s.
= 7903$\frac{3}{4}$s.;

s.	s.	oz.
∴ 7903$\frac{3}{4}$	: 15	:: 100 : Weight of coin.
4	4	
6323	1200	

20
24000(3 dwts.
18969
5031
24
120744(19 grs.
6323
57514
56907
607

= 3 dwts. 19$\frac{607}{6323}$ grs. Ans.

4. PENDA.—Given the square of 10,129 is 102,596,641, find the square of 101,293 without going through the operation of squaring. (*Barnard Smith.*)

$(101{,}293)^2 = (101{,}290+3)^2$
$= (101{,}290)^2 + 2(101{,}290\times 3) + (3)^2$
= 10,259,664,100 + 607,740 + 9
= 10,260,271,849. Ans.

5. D. McL. C., Lanark.—A sum of £3070 3s. 3d. has to be divided between A, B, and C, so that A may have $\frac{1}{2}$ of $\frac{1}{3}$ of B's share, and B $\frac{1}{2}$ of A's and C's together. Find their respective shares. (*Scholarship*, 1883.)

B's share = $\frac{1}{2}$ of A's + $\frac{1}{2}$ of C's
= $\frac{1}{2}$ of $\frac{1}{3}$ of $\frac{1}{2}$ of B's + $\frac{1}{2}$ of C's
= $\frac{1}{12}$ of B's + $\frac{1}{2}$ of C's,
B's share − $\frac{1}{12}$ of B's = $\frac{1}{2}$ of C's,
$\frac{11}{12}$ of B's share = $\frac{1}{2}$ of C's share,
∴ C's share = $\frac{11}{4}$ of $\frac{119}{138}$ of B's share
= $\frac{119}{27}$ of B's share.

A's share + B's share + C's share
= £3070 3s. 3d.,
$\frac{1}{27}$ of B's share + B's share + $\frac{119}{108}$ of B's share
= £3070 3s. 3d.,
$(\frac{1}{27}+1+\frac{119}{108})$ of B's share = £3070 3s. 3d.,
$\frac{16+108+119}{108}$ of B's share = £3070 3s. 3d.,
$\frac{243}{108}$ of B's share = £3070 3s. 3d.,
$\frac{9}{4}$ of B's share = £3070 3s. 3d.,
∴ B's share = $\frac{4}{9}$ of £3070 3s. 3d.
= £12,280 13s. ÷ 9
= £1364 10s. 4d.

A's share = $\frac{1}{27}$ of £1364 10s. 4d.
= £5458 1s. 4d. ÷ 27
= £202 3s. $0\frac{4}{27}$d.

C's share = £3070 3s. 3d.
− (£1364 10s. 4d. + £202 3s. $0\frac{4}{27}$d.)
= £3070 3s. 3d. −
£1566 13s. $4\frac{4}{27}$d.
= £1503 9s. $10\frac{23}{27}$d.

6. MAGISTER.—A and B run 100 yards, and A wins by 2 yards. C and D run over the same course, and C wins by 6 yards. B and D also run over it, and B wins by 4 yards. If A and C run, who will win, and by how much? (*Cambridge Local*, 1880.)

B runs 98 yards while A runs 100 yards;
D ,, 94 ,, C ,, ,, ,,;
B ,, 100 ,, D ,, 96 ,,;
48

∴ While D runs 96 yards C runs $\frac{100\times 96}{94}$ yds. = $\frac{4800}{47}$ yds.

50
While B runs 100 yards A runs $\frac{100\times 196}{98}$ yds. = $\frac{5000}{49}$ yds.

$\therefore$ C runs $\frac{4900}{47}$ yds. while A runs $\frac{5000}{47}$ yds. ;

$\therefore$ C runs 100 yards while A runs $\left(\frac{\cancel{4900}}{49} \times \frac{47}{\cancel{4700}} \times \cancel{100}\right)$ yds.;

$= \frac{2500}{47}$ yds.

$= 99\frac{27}{47}$ yds. ;

$\therefore$ C wins, and by $\frac{26}{47}$ yard. Ans.

7. MAGISTER.—A man mixes 5 per cent. of water with milk, which he sells to a milkman, who retails it after adding 5 per cent. of water to what he receives. What percentage of water is there in the milk retailed? (*Cambridge Local*, 1880.)

Percentage of water = 5+5+5% of 5

= 10+$\frac{1}{4}$

= $10\frac{1}{4}$. Ans.

8. EVA.—Suppose the population of a country would increase annually by ·3 per cent. were it not for emigration, which annually carries off ·5 per cent. of the people, what will be the increase per cent. in the population after 5 years? What is the population of a country from which, at the above rate, 81,000 persons emigrate in 2 years?

Annual increase = $2\frac{1}{2}$ per cent. ;

100

2·5

102·5 (end of 1 year)

$2\frac{1}{2}\% = \frac{1}{40}$ = 2·5625

105·0625 (end of 2 years)

$\frac{1}{40}$ = 2·6265625

107·6890625 (end of 3 years)

$\frac{1}{40}$ = 2·6922265625

110·3812890625 (end of 4 years)

$\frac{1}{40}$ = 2·7595322265625

113·1408212890625 (end of 5 years)

$\therefore$ Increase after 5 years = 13·1408212890625%. Ans.

Emigration in 2 years = $\frac{1}{2}\% + \left(\frac{1}{2}\% \times \frac{102\frac{1}{2}}{100}\right)$

$= \frac{1}{2}\% + \left(\frac{1}{2} \times \frac{\cancel{205}}{\cancel{200}}\right)\%$ (40, 41)

$= \frac{1}{2}\% + \frac{41}{80}\%$

$= \frac{40+41}{80}\%$

$= \frac{81}{80}\%$;

$\therefore$ Population = $81{,}000 \times \frac{80}{81} \times 100$

= 8,000,000. Ans.

9. G. C. M.—I bought 15 horses and 12 cows for £345. I sell the horses at a profit of 10 per cent., and the cows at a loss of $1\frac{1}{2}$ per cent., and receive in all £365 14s. What did I give for a horse and a cow? (*Evers.*)

(1) Cost of horses + cost of cows = £345,

(2) 10% of cost of horses − $1\frac{1}{2}$% of cost of cows = £365 14s. − £345,

$\frac{1}{10}$ cost of horses − $\frac{3}{200}$ cost of cows = £20 14s.

Cost of horses − $\frac{3}{20}$ cost of cows = £207,

(1) Cost of horses + cost of cows = £345,

$\therefore$ Cost of cows + $\frac{3}{20}$ cost of cows = £345 − £207

$\frac{23}{20}$ cost of cows = £138,

$\therefore$ Cost of cows = £138 × $\frac{20}{23}$

= £120.

Cost of horses = £345 − £120

= £225.

$\therefore$ Cost price of a horse = £225 ÷ 15

= £15 ;

" " cow = £120 ÷ 12

= £10.

10. OUSE.—Paid £30, including a duty of 5 per cent., for a Geneva watch. What did the duty amount to? (*Barnard Smith.*)

£ $\cancel{210}$: £ $\cancel{30}$ :: £ 5 : Amount of duty.

7 2

5

10

£1 8s. 6$\frac{4}{7}$d. Ans.

11. 3RD-YEAR P. T.—A can do a piece of work in 12 hours, B in 4 hours, and C 3 hours. A, B, and C all work together for half-an-hour, when A leaves off. How long will it take B and C to finish the piece of work?

A can do the work in 12 hours,

B " " " 4 " ,

And C " " " 3 " ;

$\therefore$ A " in 1 hour $\frac{1}{12}$ of the work,

B " " $\frac{1}{4}$ " ,

And C " " $\frac{1}{3}$ " ;

$\therefore$ A, B, and C " $\frac{1}{12}+\frac{1}{4}+\frac{1}{3}$ of the work

$= \frac{1+3+4}{12}$ "

$= \frac{8}{12}$ "

$= \frac{2}{3}$ " ;

A, B, and C can do in $\frac{1}{2}$ hour = $\frac{1}{2}$ of the work ;

$\therefore$ Part remaining to be done = $\frac{1}{2}$ of the work ;

B and C can do in 1 hour $\frac{1}{4}+\frac{1}{3}$ of the work

$= \frac{3+4}{12}$ "

$= \frac{7}{12}$ " ;

$\therefore$ B and C will finish the work in $(\frac{1}{2} \div \frac{7}{12})$ hours

$= \left(\frac{\cancel{2}}{1} \times \frac{12}{\cancel{7}}\right)$ hours (4)

$= \frac{6}{7}$ hours

$= 1\frac{5}{7}$ hours. Ans.

Note.—Perhaps 80 per cent.

12. BREVIS.—A certain sum of money was divided among three persons, A, B, and C. Suppose that A's share was £264 12s., and C's £2 8s., and that A's share contained the value of B's, as often as B's share contained C's, what must the whole amount have been? (*Colenso.*)

$\frac{\text{£264 12s.}}{\text{B's share}} = \frac{\text{B's share}}{\text{£2 8s.}}$,

$\frac{264\frac{1}{2}}{\text{B's share in pounds}} = \frac{\text{B's share in pounds}}{2\frac{1}{3}}$,

B's share in pounds × B's share in pounds $= 264\frac{1}{2} \times 2\frac{1}{3}$,

$(\text{B's share in pounds})^2 = \frac{1323}{5} \times \frac{7}{3}$

$= \frac{3087}{10}$,

B's share in pounds $= \sqrt{\frac{3087}{10}}$

$= 17\frac{1}{2}$

$= 25\frac{1}{2}$;

$\therefore$ B's share = £25 4s. ;

$\therefore$ Sum = £264 12s. + £25 4s. + £2 8s.

= £292 4s. Ans.

Algebra.

1. UNITY.—Solve :—

$$\frac{5x-4}{x+2} = 10 - \frac{8x-5}{5}. \quad (\textit{Mansford.})$$

$$\frac{5x-4}{x+2} = 10 - \frac{8x-5}{5}$$

$$= 10 - \left(\frac{8x}{5} - 1\right)$$

$$= 10 - \frac{8x}{5} + 1$$

$$= 11 - \frac{8x}{5}$$

$$5(5x-4) = 55(x+2) - 8x(x+2)$$

$$25x - 20 = 55x + 110 - 8x^2 - 16x$$

$$8x^2 + 16x + 25x - 55x = 110 + 20$$

$$8x^2 - 14x = 130$$

$$x^2 - \frac{7x}{4} = \frac{65}{4}$$

$$x^2 - \frac{7x}{4} + (\tfrac{7}{8})^2 = \frac{65}{4} + \frac{49}{64}$$

$$= \frac{1040+49}{64}$$

$$= 17\frac{41}{64}$$

$$x - \tfrac{7}{8} = \pm\tfrac{41}{8}$$

$$x = \pm\tfrac{41}{8} + \tfrac{7}{8}$$

$\therefore$ $x = 5$, or $-3\frac{1}{4}$.

2. D. E. K.—Find the value of:—

$$\frac{a^2}{(a-b)(a-c)}+\frac{b^2}{(b-a)(b-c)}+\frac{c^2}{(c-a)(c-b)}.$$

(*Todhunter.*)

$$\frac{a^2}{(a-b)(a-c)}+\frac{b^2}{(b-a)(b-c)}+\frac{c^2}{(c-a)(c-b)}$$
$$=\frac{a^2}{(a-b)(a-c)}+\frac{b^2}{-(a-b)(b-c)}+\frac{c^2}{-(a-c)\times-(b-c)}$$
$$=\frac{a^2}{(a-b)(a-c)}-\frac{b^2}{(a-b)(b-c)}+\frac{c^2}{(a-c)(b-c)}$$
$$=\frac{a^2(b-c)-b^2(a-c)+c^2(a-b)}{(a-b)(a-c)(b-c)}$$
$$=\frac{a^2b-a^2c-ab^2+b^2c+ac^2-bc^2}{a^2b-ab^2-a^2c+ac^2+b^2c-bc^2}$$
$$=1.\quad \text{Ans.}$$

3. 4TH YEAR P. T.—There are two numbers; if one-fifth of the second be taken from it and added to the first, they will be equal; but if one-third of the first be taken from it and added to the second, then the second will be three times as great as the first. Find the original numbers. (*Moffatt's* 'Pupil Teachers' Course.')

Let x and y = the two numbers;

Then, (1) $x+\frac{y}{5}=\frac{4y}{5}$

(2) $\frac{2x}{3}\times 3=y+\frac{x}{3}$

(1) $x=\frac{4y}{5}-\frac{y}{5}$

(2) $2x-\frac{x}{3}=y$

(1) $x=\frac{3y}{5}$

(2) $\frac{5x}{3}=y$

(1) $5x=3y$

(2) $5x=3y$

∴ Any multiples of 3 and 5 satisfy the conditions.

∴ Nos. = 3 and 5, or 6 and 10, or 9 and 15, etc.

Note.—The question is not complete. A similar one from the same work was solved in our issue for June, 1884.

4. J. WM. ALLEN.—Twenty men are employed on a certain work, only eighteen of them, however, working at one time, while the other two are resting. A change is made in the group at work every hour. How many hours will have elapsed before every possible group has been at work together for one hour? (*Cassell's* 'Saturday Journal.')

$$\text{No. of combinations}=\frac{\cancel{20}.19}{1.\cancel{2}}$$
$$=190;$$

∴ Time = 190 hours. Ans.

5. NOBODY.—A person having invested £2,000 in the 3 per cents., and £3,300 in the 3½ per cents., derives therefrom an income of £211 5s. If his investment had been £550 more in the former and £550 less in the latter, his income would have been just 2s. 6d. more. What were the respective prices of stock? (*Colenso.*)

Let x and y = Prices of stocks in pounds;

Then, (1) $\left(\frac{2000}{x}\times 3\right)+\left(\frac{3300}{y}\times 3\frac{1}{2}\right)=211\frac{1}{4}$

(2) $\left(\frac{550}{x}\times 3\right)-\left(\frac{550}{y}\times 3\frac{1}{2}\right)=\frac{1}{8}$

(1) $\frac{6000}{x}+\frac{23100}{2y}=211\frac{1}{4}$

(2) $\frac{1650}{x}-\frac{3850}{2y}=\frac{1}{8}$

(1) $\frac{6000}{x}+\frac{23100}{2y}=211\frac{1}{4}$

(2) $\frac{9900}{x}-\frac{23100}{2y}=\frac{3}{8}$

$$\frac{15900}{x}=211\frac{3}{8}$$
$$=212$$

∴ $x=\frac{15900}{212}$

$=75.$

(2) $\frac{1650}{x}-\frac{3850}{2y}=\frac{1}{8}$

$\frac{1650}{75}-\frac{3850}{2y}=\frac{1}{8}$

$22-\frac{1}{8}=\frac{3850}{2y}$

$21\frac{7}{8}=\frac{3850}{2y}$

$21\frac{7}{8}=\frac{3850}{2y}$

$\frac{22}{}$

∴ $y=\frac{\cancel{3850}}{\cancel{2}}\times\frac{4}{\cancel{175}}$

$=88.$

∴ Prices of stocks = 75 and 88.

6. J. BURROWS.—Simplify:—

$$(x+3)^3-3(x+2)^3+3(x+1)^3-x^3.$$
$$(x+3)^3-3(x+2)^3+3(x+1)^3-x^3$$
$$=x^3+9x^2+27x+27-3(x^3+6x^2+12x+8)$$
$$+3(x^3+3x^2+3x+1)-x^3$$
$$=9x^3+27x+27-3x^3-18x^2-36x-24+3x^3+9x^2+9$$
$$x+3$$
$$=6.\quad \text{Ans.}$$

7. CYCLOPS.—Solve:—

$$\left.\begin{aligned}7yz&=10(y+z)\\3zx&=4(z+x)\\9xy&=20(x+y)\end{aligned}\right\}$$

Todhunter's 'Algebra for Beginners.'

$$\left.\begin{aligned}&(1)\ 7yz=10(y+z)\\&(2)\ 3zx=4(x+z)\\&(3)\ 9xy=20(x+y)\end{aligned}\right\}$$

(2) $3zx=4(x+z)$

$=4x+4z$

$3zx-4z=4x$

$(3x-4)z=4x$

$$\therefore\ z=\frac{4x}{3x-4}.$$

(3) $9xy=20(x+y)$

$=20x+20y$

$9xy-20y=20x$

$(9x-20)y=20x$

$$\therefore\ y=\frac{20x}{9x-20}$$

(1) $7yz=10(y+z)$

$$7\times\frac{20x}{9x-20}\times\frac{4x}{3x-4}=10\left(\frac{20x}{9x-20}+\frac{4x}{3x-4}\right)$$
$$\frac{560x^2}{(9x-20)(3x-4)}=10x\left\{\frac{20(3x-4)+4(9x-20)}{(9x-20)(3x-4)}\right\}$$
$$56x=60x-80+36x-80$$
$$56x-96x=-160$$
$$-40x=-160$$
$$\therefore\ x=4.$$
$$y=\frac{20x}{9x-20}=\frac{80}{36-20}=\frac{80}{16}=5;$$
$$z=\frac{4x}{3x-4}=\frac{16}{12-4}=\frac{16}{8}=2.$$

8. CYCLOPS.—Resolve into factors:—

$x^2-y^2-3x-y+2$. (*Harrow School Entrance Scholarship*, 1884.)

First Method.

$$x^2-y^2-3x-y+2$$
$$=x^2-3x+2-y-y^2$$
$$=(x^2-3x+2)-2y+y+xy-xy-y^2$$
$$=(x^2-3x+2)+xy-2y-xy+y-y^2$$
$$=(x-2)(x-1)+y(x-2)-y(x-1)-y^2$$
$$=(x-2)(x-1)+y\{(x-2)(x-1)\}-y^2$$
$$=\{(x-2)-y\}\{(x-1)+y\}$$
$$=(x-2-y)(x-1+y)$$
$$=(x-y-2)(x+y-1).\quad \text{Ans.}$$

Second Method.

$$\begin{aligned}&x^2-y^2-3x-y+2\\&=(x^2-y^2)-2x-2y-x+y+2\\&=(x^2-y^2)-2(x+y)-(x-y)+2\\&=(x+y)(x-y)-\{2(x+y)+(x-y)\}+2\\&=\{(x+y)-1\}\{(x-y)-2\}\\&=(x+y-1)(x-y-2).\end{aligned}$$ Ans.

Note.—The second method is simpler.

9. STUDENT.—Solve:—

$$\left.\begin{aligned}x^2+y^2-xy(x+y+2)+x^2y^2&=31\\x+y+xy&=11\end{aligned}\right\}$$

(*Certificate, Second Year*, 1884.)

$$\left.\begin{aligned}&(1)\quad x^2+y^2-xy(x+y+2)+x^2y^2=31\\&(2)\quad x+y+xy=11\end{aligned}\right\}$$

Substituting from (2):

$$(1)\quad x^2+y^2-xy(x+y+xy)-2xy+2x^2y^2=31$$

$$x^2+y^2-11xy-2xy+2x^2y^2=31$$

$$x^2+y^2=13xy-2x^2y^2+31.$$

$$(2)\quad x+y=11-xy$$

$$(x+y)^2=(11-xy)^2$$

$$x^2+2xy+y^2=121-22xy+x^2y^2$$

$$x^2+y^2=121-24xy+x^2y^2.$$

$$\therefore\ 121-24xy+x^2y^2=13xy-2x^2y^2+31$$

$$x^2y^2+2x^2y^2-24xy-13xy=31-121$$

$$3x^2y^2-37xy=-90$$

$$x^2y^2-\frac{37xy}{3}=-30$$

$$x^2y^2-\frac{37xy}{3}+(\tfrac{37}{6})^2=\tfrac{1369}{36}-30$$

$$=\frac{1369-1080}{36}$$

$$=\tfrac{289}{36}$$

$$xy-\tfrac{37}{6}=\pm\tfrac{17}{6}$$

$$xy=\pm\tfrac{17}{6}+\tfrac{37}{6}$$

$$\therefore\ xy=9,\text{ or }\tfrac{10}{3}.$$

$$(2)\quad x+y=11-xy$$

$$=11-9$$

$$=2$$

$$\left.\begin{aligned}x^2+2xy+y^2&=4\\4xy&=36\end{aligned}\right\}$$

$$x^2-2xy+y^2=-32$$

$$(x-y)^2=-32.$$

Now as the square of any quantity is positive, the value $xy=9$ is inapplicable.

$$(2)\quad x+y=11-\tfrac{10}{3}$$

$$=\tfrac{23}{3}$$

$$\left.\begin{aligned}x^2+2xy+y^2&=\tfrac{529}{9}\\4xy&=\tfrac{40}{3}\end{aligned}\right\}$$

$$x^2-2xy+y^2=\tfrac{409}{9}$$

$$(x-y)^2=\tfrac{409}{9}$$

$$\left.\begin{aligned}\therefore\ x-y&=\frac{\pm\sqrt{409}}{3}\\x+y&=\tfrac{23}{3}\end{aligned}\right\}$$

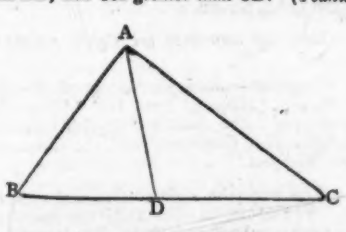
$$\therefore\ 2x=\frac{23\pm\sqrt{409}}{3},$$

$$2y=\frac{23\mp\sqrt{409}}{3};$$

$$\therefore\ x=\tfrac{1}{2}(23\pm\sqrt{409}),\text{ and }y=\tfrac{1}{2}(23\mp\sqrt{409}).$$ Ans.

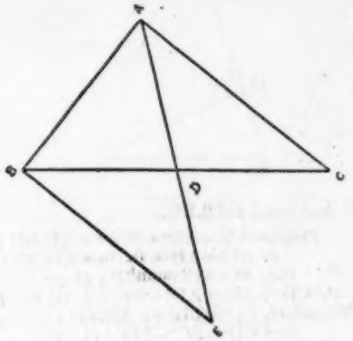
Geometry.

1. J. YOUNG.—ABC is a triangle, and the angle A is bisected by a straight line which meets BC at D; show that BA is greater than BD, and CA greater than CD. (*Todhunter.*)



Proof.—$\angle$ BDA is greater than $\angle$ CAD; (I. 16.)
$\angle$ CAD = $\angle$ BAD; (Hyp.)
$\therefore$ $\angle$ BDA is greater than $\angle$ BAD;
Wherefore side BA is greater than side BD (I. 19.)
Similarly it can be proved that CA is greater than CD.
Q. E. D.

2. W. THOMSON.—The two sides of a triangle are together greater than twice the straight line drawn from the vertex to the middle point of the base. (*Todhunter.*)

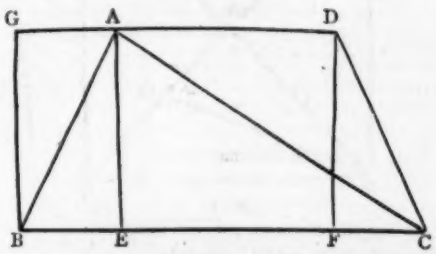


Let ABC be a triangle, and D the middle point of the base BC. Join AD. Then AB and AC together shall be greater than twice AD.

Produce AD to E, so that DE s equal to AD. Join BE.

Proof.—In the two triangles ADC, EDB, the two sides AD, DC = the two sides ED, DB, each to each,
and $\angle$ ADC = $\angle$ EDB; (I. 15.)
$\therefore$ base AC = base BE. (I. 4.)
The two sides AB, BE are greater than AE; (I. 20).
$\therefore$ The two sides AB, AC are greater than AE, that is, greater than twice AD.
Q. E. D.

3. G. F. A. BOLDMERE.—If the two sides of a trapezium be parallel, show that its area is equal to that of a rectangle contained by its altitude and half the sum of its parallel sides. (*Christ's College, Cambridge*, 1851.)



Let ABCD be a trapezium, having the sides AD, BC parallel. Then the area of the trapezium ABCD shall be equal to the area of the rectangle contained by half the sum of AD, BC, and the altitude of the trapezium.

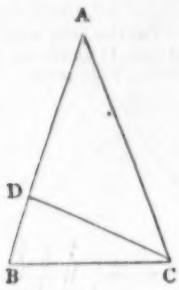
Draw AE, DF perpendicular to BC, and BG perpendicular to DA produced.

Proof.—$\triangle$ ABC = $\frac{1}{2}$ rectangle GBFD (I. 41), that is, $\frac{1}{2}$ rectangle contained by BC.AE;
$\triangle$ ACD = $\frac{1}{2}$ rectangle AE.FD, that is, $\frac{1}{2}$ rectangle contained by AD.AE;
$\therefore$ $\triangle$ ABC + $\triangle$ ACD = $\frac{1}{2}$ rectangle BC.AE + $\frac{1}{2}$ rectangle AD.AE;
$\therefore$ Area of trapezium ABCD = $\frac{1}{2}$ area of rectangle contained by (BC + AD).AE
= Area of rectangle contained by $\frac{1}{2}$(AD + BC).AE.
Q. E. D.

4. WILL O' TH' WISP.—From one of the equal angles of an isosceles triangle, a perpendicular is drawn to the opposite side.

Show that the square on the base is equal to twice the rectangle contained by that side, and the part of it between the perpendicular and the base. (*Deduction to Euclid*, II. 4.)

Let ABC be an isosceles triangle, and let CD be drawn perpendicular to AB.

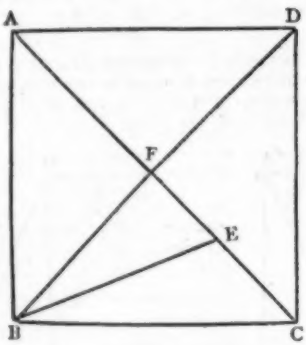


Then, BC^2 shall equal 2 AB.BD.

Proof.—$AB^2 = AD^2 + BD^2 + 2\ AD.BD$ (II. 4).
$\therefore\ AC^2 = AD^2 + BD^2 + 2\ AD.BD$;
But, $AC^2 = CD^2 + AD^2$; (I. 47.)
$\therefore\ CD^2 + AD^2 = AD^2 + BD^2 + 2\ AD.BD$;
Wherefore, $CD^2 = BD^2 + 2\ AD.BD$; (Ax. 3.)
And $CD^2 = BC^2 - BD^2$; (I. 47.)
$\therefore\ BC^2 - BD^2 = BD^2 + 2\ AD.BD$;
Wherefore, $BC^2 = 2\ BD^2 + 2\ AD.BD$ (Ax. 2.)
$= 2\ (BD^2 + AD.BD)$
$= 2\ AB.BD$. (II. 3.)
Q. E. D.

Note.—It can be proved directly from II. 13, Case 1.

5. NATAL.—ABCD is a square, and AC a diagonal. In AC a point E is taken. Show that the triangle, whose sides are equal to AE, EC, and the diagonal of square described on BE, will contain a right angle. (*Deduction to* II. 9.)



Let the diagonals AC, BD intersect in F.

Proof.—$AE^2 + EC^2 = 2AF^2 + 2EF^2$ (II. 9.)
$= 2BF^2 + 2EF^2$
$= 2BE^2$ (I. 47.)
= Square of the diagonal of a square described on BE;

$\therefore$ The triangle described with sides equal to AE, EC, and the diagonal of a square on BE, is right-angled. (I. 48.)
Q. E. D.

General.

1. P. T.—The solution of your query appeared in our *last* issue.

2. M. R. S.—Your query was solved in our issue for June, 1884. See No. 5 of Algebraical Queries.

3. DARIUS.—You will find the solution of your query in our issue for March, 1884.

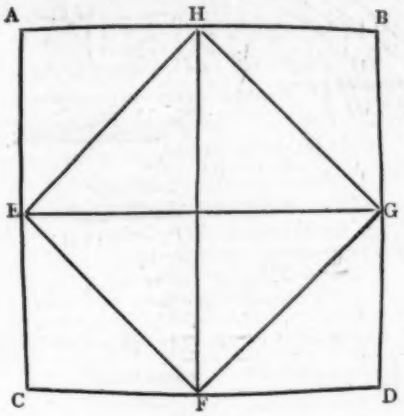
4. FRANK.—The solution of your query appeared in our issue for November, 1882. See model answers to Scholarship Questions.

5. BOUNCING BOY.—If you will kindly comply with Rules 2 and 3 of the query column, we shall have pleasure in replying to your query.

6. GWILYM TIMOTHY JONES.—We do not reply to anonymous queries.

7. DON CÆSAR.—You will find the solution of your first query in our issue for April, 1882, and the solution of your second in our issue for December, 1884.

8. POM-POM.—To cut away half a square, and leave a square as high and as wide as it was before. EFGH is half the size of



ABCD; it is also a square, and EG is equal to AB, and FH to AC.

9. MEMORY AND SUCCESS, AND I. B. S. O. S.—We cannot possibly tell you what you want to know. You must use your judgment. You seem to think few people can remember anything. This is not true. Very many would like to learn the art of forgetting. In the absence of revelation you should be guided by science. All that is known about mental development you will find in *Prof. Sully's* 'Outlines of Psychology' (Longman and Co.

10. CONSTANT READER.—Read the syllabus to see which essays, and how many. Get *Abbott's* edition as well. You have a play of Shakespeare to prepare; use the Clarendon Press Edition, together with *Abbott's* 'Shakespearian Grammar.' Your list of books seems sufficient. Mind your spelling, and where you put capitals and apostrophes.

11. DON'T KNOW.—Your writing is very poor indeed. Get good copy-books and practise daily.

12. NOV. NAV.—The subject is too extensive to be dealt with in the query column. Consult some qualified person, and ask for detailed instructions.

13. E. W. SYLVESTER.—Small hand, 75; large hand, 80.

14. EXCELSIOR.—Yes, and more will do so. Enter if you can. Many Boards only recognise trained teachers.

15. SCIENTIST.—(1) It means that teachers receive marks for one or two sciences if they hold certificates for them, but not for more than two. (2) It is hard to say. *Fownes'* 'Manual' is exceedingly good: last edition 1883.

16. FERGUS STEWART.—Elliott and Co., Strand; Becker and Co., Maiden Lane, Strand.

17. W. P.—Both the sentences are right. 'Avus magistro agros dat.'

18. JOHN WILLIAMS.—*Mackay's* 'Geography,' and *Hewett's* 'Colonies.' *Hume's* 'History,' Part III. 'The Nineteenth Century,' by *Nelson*. *Dr. Smith's* 'English Grammar,' *Dr. Abbott's* 'Shakespearian Grammar,' and the Clarendon Press Edition of the 'Tempest.'

19. O. M.—You have the right edition, and seem to have a good method. You do not need to know the text so familiarly as if you were reading a book of Milton. The best thing for you to do would be to refer to the last three calendars, and see the sort of questions set upon similar books.

20. LEGON.—It is difficult to say which is the best. *Dr. Smith's* 'French Principia' is very good. *Fasnacht's* course is shorter; but there are many excellent books. You cannot get the pronunciation from books alone. You may consult the lessons passing through the *Scholar* with advantage.

21. ZANONI.—Are you sure the question was put as you say? We will then give you an answer, and some advice into the bargain.

22. W. T. SOUTHERN.—Your hand-writing in no case reaches fair; a Fourth Standard boy should do better.

23. IL PENSEROSO.—(1) Cannot say: most likely all equal. (2) You cannot possibly get to know the exact number of marks. One would think honours worth most. (3) A second stage in mathematics would not count for the Second Year's Papers.

24. SUBSCRIBER.—(1) 75; (2) 65.

Write to the Registrar of the London University for a Syllabus of the Matriculation Examination, and also one for degrees in science. You will find all you want in them. Always read your letters before sending them.

25. B. SCRIBE.—All equal in value. Hold your pen properly. The lower curves are heavy, and the letters too far apart.

26. J. E. R.—Writing too upright; capitals badly shaped; connections abrupt, and curves far too flat. Take our advice, and don't try to get a science certificate by reading *Huxley's* 'Lessons in Physiology' (not Phisiology, as you write it). You cannot learn Physiology by reading a book. Persons have been known to get certificates by so doing, but they lose more than they gain. Give the time to French and drawing.

27. ELLEN FORD.—65. Shape of letters very fair. Dont paint the large-hand. Small-hand is good. Keep to the round style of writing.

28. J. EDWARDS.—By Boyle's law, the volume occupied by a gas varies inversely as the pressure. The law can be verified: see PRACTICAL TEACHER, Vol. IV., page 217. As the cross section of the cylinder will continue the same, the length of the column will vary inversely as the pressure. Let x equal the length of the cylinder, then

$$20x = 30\,(x-2)$$
$$10x = 60; \qquad \text{whence } x = 6.$$

29. CONSTANT SUBSCRIBER.—For the 'Tempest' use *Clarendon Press* edition. *Hume's* 'History' is suitable; it is published in parts. You want Part III. The syllabus of school management is now much extended. You need to study some elementary logic, say *Jevon's* 'Primer,' and also some mental science, which can only be got at present from *Prof. Sully's* 'Psychology' (Longman and Co.) Use *Curwen's* 'Manuals for Music.' There is no arithmetic in the Second Year's Papers.

30. UN AMI FIDELE.—The questions set last year are published, and can be had for 6d. through any bookseller. You ought to succeed. Use *Findlater's* 'Physiography,' and especially *Huxley's*.

31. PUZZLED.—Would you kindly repeat your query, as you have evidently copied it incorrectly?

32. E. BONARIA.—If $A+B+C=90°$, prove that

$$\text{Cot } A + \text{cot } B + \text{cot } C = \text{cot } A \text{ cot } B \text{ cot } C.$$

(*Civil Service*, 1879.)

$$\text{Cos } (A+B+C) = \text{Cos } 90° = 0;$$

$$\begin{aligned}\text{And Cos } (A+B+C) &= \text{Cos } \{A+(B+C)\} \\ &= \text{Cos } A \text{ cos } (B+C) - \text{sin } A \text{ sin } (B+C) \\ &= \text{Cos } A \text{ (cos } B \text{ cos } C - \text{sin } B \text{ sin } C) \\ &\quad - \text{sin } A \text{ (sin } B \text{ cos } C + \text{sin } C \text{ cos } B) \\ &= \text{Cos } A \text{ cos } B \text{ cos } C - \text{sin } B \text{ sin } C \text{ cos } A \\ &\quad - \text{sin } A \text{ sin } B \text{ cos } C - \text{sin } A \text{ sin } C \text{ cos } B;\end{aligned}$$

$$\therefore \text{Cos } A \text{ cos } B \text{ cos } C - \text{sin } B \text{ sin } C \text{ cos } A - \text{sin } A \text{ sin } B \text{ cos } C - \text{sin } A \text{ sin } C \text{ cos } B = 0,$$

Wherefore,

$$\text{Cos } A \text{ cos } B \text{ cos } C = \text{Sin } B \text{ sin } C \text{ cos } A + \text{sin } A \text{ sin } B \text{ cos } C + \text{sin } A \text{ sin } C \text{ cos } B,$$

(Dividing by sin A sin B sin C),

$$\frac{\text{CosA}}{\text{SinA}} \cdot \frac{\text{CosB}}{\text{SinB}} \cdot \frac{\text{CosC}}{\text{SinC}} = \frac{\text{CosA}}{\text{SinA}} + \frac{\text{CosC}}{\text{SinC}} + \frac{\text{cos B}}{\text{sin B}},$$

$$\text{Cot A cot B cot C} = \text{Cot A} + \text{cot C} + \text{cot B};$$

$$\therefore \text{Cot A} + \text{cot B} + \text{cot C} = \text{Cot A cot B cot C}.$$

33. TUTUS DUM RECTUS.—The sentence is elliptical and exclamatory. The ellipsis may be supplied as below.

Sentence.	Kind of Sent.	Subj.	Predicate.	Object.	Extension.
(*a*) Now by the lips of those fair gentlemen of France, charge for the golden lilies—upon them with the lance.	Princ. Sent. contracted in subj. and pred.	[I]	[bid]	You fair gentlemen of France (dir. object) [to] charge for the golden lilies—[to set] upon them with the lance.	Now (time) by the lips of those (reason)
(*b*) Ye love.	Adj. to 'those' in (*a*)	ye	love		

34. STORM.—Turn to Todhunter's "Mechanics for Beginners," p. 272, and use the formula there established. Any good book on dynamics embraces what you want.

35. GENTIL.—We did not ask you to repeat the query, but to state where your difficulty lay, so that we could assist you. Read the book we named, and study it. You will be rewarded.

Matriculation Hints.

BY HENRY A. REATCHLOUS, M.A. (LOND.), B.Sc.,
Westminster Training College.

THE ENGLISH LANGUAGE, ENGLISH HISTORY, AND MODERN GEOGRAPHY.—Under the head of English the syllabus specifies orthography, writing from dictation, and the grammatical structure of the language. This would of itself be somewhat vague. The candidate should look at the questions set at the last three or four examinations. He will then get a pretty clear notion of what is expected. As regards the dictation exercise, it need only be said that it is generally a piece from some standard author, and fills a page of the answer-book. It is read three times; once to get the drift of it, a second time to write it, and a third time to correct and punctuate it. It is usually read rather rapidly. It would therefore be well for the candidate to ask a friend to read a few pieces to him by way of practice, or he may become confused on the examination day.

For the rest of the paper considerable preparation is necessary. It is not easy to name any one book in preference to the rest. There are many good manuals in use. Possibly our readers have already a fair knowledge of grammar, and can parse and analyse with ease. All they need in addition would be found in 'The Elementary Lessons in Historical English Grammar,' by Morris (Macmillan, 2s. 6d.). Dr. Smith's 'School Manual of English Grammar' (Murray, 3s. 6d.) contains in itself probably all that would be required. It is a good book. The student would do well to make it a sort of text-book, and consult some other books on special points. If he intends proceeding to a degree in arts, he may very well do more English than will be barely enough for the matriculation. Dr. Abbott's 'How to Parse,' and the introduction to his 'Shakespearean Grammar,' are well worth consulting. Books like Trench's 'English Past and Present,' and his 'Study of Words,' and Dean Alford's 'Queen's English,' are light and easy reading, and at the same time very instructive.

In regard to the English history, it will also be advisable to consult the questions set within the last two years. It will be most likely admitted that the questions are such as might be expected. To answer

them satisfactorily one must have read a good history and become fairly well acquainted with it. The 'Student's Hume' (price 7s. 6d.) would, we think, meet all requirements. If some parts of Green's 'Short History of the English People' (price 8s. 6d.) could be read too, so much the better. It must be remembered that the history and geography bring as many marks as Greek or French. The examiners are right therefore in expecting that a fair amount of time and attention should be bestowed upon this part of the work. The answers should be clearly thought out and well expressed. Above all, gross blunders and guesses should be avoided. They may often just turn the scale and secure a candidate's rejection.

Modern geography is included in the paper on history. Usually four questions are set, two of which must be attempted. Of course the words modern geography may stand for a good deal. A student, however, who is pressed for time may content himself with preparing the geography of the British Isles and the Colonies. He should also pay attention to places of interest at the time of the examination. Mackay's 'Geography' and Hewett's 'Colonies' will be quite enough, if used in connection with a good recent atlas. A neat map adds considerably to the value of an answer.

In conclusion, a few words on the manner of answering questions may not be out of place. There must be a very general impression abroad that penmanship and neatness count for little. In no other way could the badness of the writing and want of style be accounted for. It is pretty certain that in future candidates will be expected to leave their answers in a more readable form. Indeed, they were cautioned at the last examination by the registrar against sending in books that required more time to decipher than the examiners could afford. The writing from beginning to end should be perfectly and easily legible. One should be able to see at a glance where one question ends and another begins. The number of each question should be attached to the answer to it. In the case of arithmetic and algebra the result may be underlined. The steps by which it was obtained should be easy to trace.

The use of instruments is allowed. There is, therefore, no excuse for slovenly figures in geometry. The letters in the diagrams and in all references to them should be printed, not written. All recognised contractions can be employed. It is quite possible, therefore, to arrange the steps in the reasoning so that each important statement occupies one line. In the papers on natural philosophy diagrams should be a special feature. They should be neatly drawn, and in such a way as to show that the candidate knows what is essential in a piece of apparatus, and knows how to set it up so that it will work. Even where a diagram is not asked for it may be desirable to draw one. It helps the candidate to realise the conditions of the problem he has to solve. Diagrams are equally necessary in answering the chemistry paper. A few well-drawn figures will do more to make it clear to the examiner that the candidate understands the subject than pages of directions and descriptions. Finally, the answers should be looked over, even if hastily, before they are left. Mistakes would often be detected and marks saved. Candidates often forget to put their numbers upon their books; occasionally they put a wrong number upon them. They should not be surprised, then, to learn that they do other foolish things, which a rapid revision of their work would enable them to rectify.

Style, some may think, means very much more than has yet been said. And no doubt it does. The selection of the matter, the method of arranging it, the expression of it, far more than the mere penmanship, enter into the style of answering. We have simply insisted on the part which should never be absent, and which lies within the reach of all. But while it is within the reach of all it is not reached by one in five, perhaps much less. Allowance must be made for nervousness and excitement; when that has been done there remains much room for improvement, and if the candidates realised how greatly it would add to their chance of success, they would not be slow to give attention to it.

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Publications Reviewed.

Patent Mechanical Globe. Designed by W. Rice, F.R.G.S. London and Liverpool: George Philip and Son.

The *raison d'etre* of this ingeniously-devised apparatus is to supply teachers with a handy means of illustrating those complex motions of the earth, with respect to the sun and to the plane of its own orbit, which give rise to the alternation and varying lengths of day and night, the succession of the seasons, and the various other concomitant phenomena. Exigencies of space forbid us from entering into a detailed description of Mr. Rice's invention, and the method of using it. That method is described in the explanatory pamphlet supplied with the apparatus, and it must suffice for us to say that, if the reader can imagine a square blackboard, with a large circular opening in it, mounted upright on a stand, and in that opening a brass ring rotating on vertical pivots, with a globe mounted in that ring so as to revolve on an axis 23½ degrees out of the perpendicular, he will be able to form a fair idea of its appearance. We may add that the position of the sun is indicated by a brass ball fixed on a semi-circular brass wire in front of the instrument, and that, of course, that half of the rotating globe which is on the same side of the blackboard as the brass ball is supposed to be enjoying day-time, and that on the opposite side night. We must cogratulate the inventor on having given to the teaching profession an instrument which, if properly used, can hardly fail to convey clearer ideas of the diurnal and annual motions of our globe, and the effects thereof, than the most elaborate of diagrams.

The 'Selenotrope.' Designed by W. Rice, F.R.G.S. London and Liverpool: George Philip and Son.

This apparatus, devised by the same inventor as the Mechanical Globe above referred to, is, as the name implies, a means of illustrating the phases of our satellite, the moon. It affords so clear and ready a means of doing this that our only wonder is that the instrument was not invented long ago. The plan pursued is somewhat similar to that previously described in the case of the Mechanical Globe, consisting of a globe, painted half white and half black, rotating in a circular aperture in a square blackboard. The position of the sun is given by a brass ball, revolving by means of a wire framework round the central globe; and the only inaccuracy we can detect in the whole instrument is that in the specimen now before us for our examination the brass ball representation of the sun is not placed sufficiently high to correctly define its position with respect to the lit-up portion of the lunar surface. In good hands the Selenotrope, like the Mechanical Globe, can hardly fail to be of good service.

Free England; or, Old Stories of the English Parliament. By H. E. B. London: Jarrold and Sons, 3, Paternoster Buildings.

In the preface to this beautiful little volume, the writer says that it is not intended so much for schoolroom use as with the hope that here and there some schoolboy taking it up of his own accord may find a pleasure in these stories of England's liberties. We are of opinion, however, that it would be very difficult to find a more suitable volume to place in the hands of our elder boys in school, as well as those about to enter upon work, to give them a desire for studying such things as will fit them for their own future duties as good citizens. As a reader for the sixth and seventh standards, or as a prize book to boys leaving school, the book is equally suitable.

In ten chapters, with upwards of twenty subdivisions, the writer, in admirable language, tells the story of the struggles for constitutional liberty in this country. Beginning with 'The Barons and Magna Charta,' the several stages in the contest are marked as follows: 'Simon de Montfort, the Founder of the House of Commons,' 'Edward I. and the Shaping of the English Constitution,' 'Sir John Eliot and the Petition of Right,' 'John Hampden and the Great Rebellion,' 'The Revolution of 1688,' 'William Pitt,' 'The Abolition of the Slave Trade,' 'Catholic Emancipation,' and 'The Reform Bill.'

Each of these chapters is thoroughly well written, and the story of the various battles and triumphs in the cause of freedom is made quite as interesting as a novel.

In the Blue Book for 1882, one of Her Majesty's Inspectors said, 'Less time might well be given to the mere committal to memory of strings of battles and dates, and more attention paid to the study of noble lives and characters, and the gradual development of our laws and constitution.'

Both these points are attended to in the volume before us, and it has our heartiest approval, for writer, printer, and publisher have all combined to produce an interesting and beautiful book.

The Teachers' Diary and Pocket Book. London: Jarrold and Sons.

To this excellent idea, admirably carried out, we give our heartiest approval. This, the third yearly issue, is a distinct advance upon any of its predecessors, yet without increasing the bulk of the book. Among the new matter which the present issue contains will be found the latest alterations in the Code, the revised instructions to Inspectors, the new needlework exercises for the examination day, forms on which to tabulate the results of test examinations in each standard, the entrance fees at the various training colleges, and a calendar for 1886, which will be of service to many teachers in calculating the commencement of the last twenty-two weeks of the school year. We can confidently and cordially recommend it to every English elementary teacher.

Charity Moore. By Lina Ormon-Cooper. With illustrations by T. Pym. London: Hodder and Stoughton.

It is difficult to understand with what object such books as this—for 'Charity Moore' is but one of a large class—are written. Their matter and manner are as ill-suited to boys and girls as to very young children; their maudlin sentiment and false morality are obnoxious; their 'religion' must be positively painful to any sincerely religious mind. Long death-bed repentances and 'truly Christian deaths'—both favourite themes—are neither pleasant nor suitable reading for young children. Why this constant harping upon death? The children will learn all too soon the meaning of death, the bitterness of loss, the pain of parting from the beloved. Meantime, if we must speak to our children of death, to them, at least, let it mean nothing but a long, sweet sleep, the longest, calmest, sweetest sleep of all. If the writers of these so-called 'religious' stories would but remember the words, 'Suffer little children to come unto Me,' the tenderness of them would be a lesson and a warning. They would then no longer try to make small children sad and ludicrous caricatures of their elders; they would no longer attempt to make the fresh, young minds like those of the older and less pure; they would, in speaking to little children, strive to become as 'one of these,' and not force the little ones to become like unto themselves.

Charity Moore is a little girl who has been left by her father at a workhouse, when only six weeks old. She manages one day to save a little girl from being run over, and is thereupon taken as nursemaid by the mother of the little girl. Then Charity passes through a variety of adventures, always with the same self-conscious air of superior virtue that is very irritating. In the end she marries an elderly admirer. But before this final reward of virtue, her father, of course, turns up. He is drunk and dissolute, and Charity, having been abandoned by him when a baby, of course feels it incumbent upon her to abandon in turn her lover, her friends, and her home, to go with her parent. This sense of duty does not, how-

ever, prevent her from writing to her lover after her father's death—(and the preaching to the dying man by his daughter is particularly objectionable)—that 'father has gone home *at last*, now I am ready to come to you.' There is an exultation about that 'at last' which is hardly pleasant.

There are various passages in this little volume which we feel bound to denounce very strongly. To tell small children that 'quite often mothers leave their babies,' *i.e.*, at the workhouse, 'when they are ashamed of them,' is surely unnecessary. It is bad enough to think that some day children will know that mothers *can* be driven into being ashamed of their own children, without forcing this knowledge upon them. Nor do we think it well to call the attention of little ones specially to certain passages in the Old Testament, as Miss or Mrs. Cooper does.

We would also earnestly advise Mrs. Cooper, who finds her English quite as much as she can manage, not to attempt French. 'Je *vive* en espoir,' even supposing she had not made the slip in her verb, would still be un-French—a mere putting into French words of an idiomatic English phrase.

The book is nicely got up, so nicely that we wish its contents were worthy of its binding and printing; and the illustrations, albeit the illustrator forgets sometimes which of the heroines is dark and which is fair, and consequently gets them a 'little mixed,' are pretty enough.

Guide Book for Pupil Teachers. By James Beveridge. London and Edinburgh: W. and R. Chambers.

This is simply a reprint of two years' papers set for candidates and first year pupil-teachers in Scotland, with about a dozen solutions of questions in arithmetic and analysis. It will be useful in Scotch schools, where candidates for apprenticeship are still examined separately, but will not serve as a guide to the work in English schools, the codes of the two countries not being alike. It is well printed, and the answers to the four hundred questions in arithmetic are appended.

Paragon Readers. IV. and V. Manchester: John Heywood.

Both these volumes maintain the excellence of the earlier numbers in the series. They are well bound, clearly printed, and suitably illustrated. The matter in both volumes has been skilfully chosen, for while well-tried fields of literature have been gleaned from, an unusually large number of pieces, especially in the Fifth Reader, are such as are not usually found in school books. Modern writers, as Macaulay, Speke, Washington Irving, Scott, McCarthy, and others, have been laid under contribution; the whole selection reflecting much credit upon the editor of the series. Teachers will find them very suitable for their respective standards.

The 'E.S.A.'s' Test Cards. Standards II. to VII. London: The Educational Supply Association, Limited, Holborn Viaduct.

Another set of test cards under the above title is presented for approval.

Those before us occupy a medium place as regards difficulty. Their compilation has not involved any serious trouble, for they almost invariably consist of three plain sums in figures, and an easy problem to each test. There are two tests or eight sums on each card, and on the reverse side two columns of spellings, arranged with regard to the requirements of each standard. The examples are scarcely varied enough. In Standard V., for instance, every test begins, 'Make out the following bill.' Then follow a sum in addition and subtraction of fractions, always of the same pattern, a sum in compound practice, and one in proportion. A child who could work one card might fairly, therefore, be supposed to be able to work them all. The cards are in cloth cases, and each case contains a card of answers on cloth.

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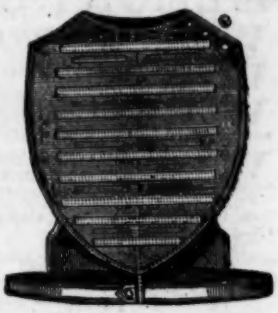

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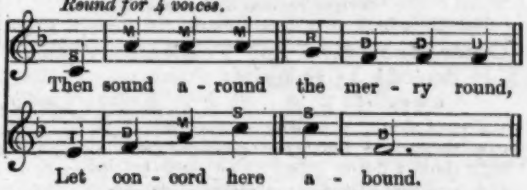

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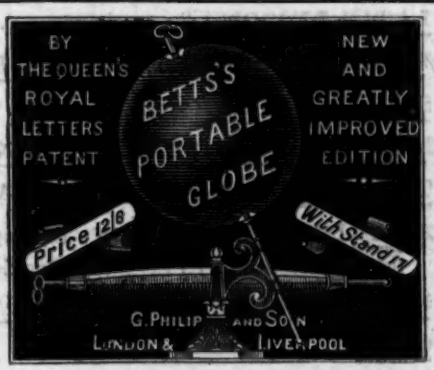

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